SOCIO-TECHNICAL APPROACHES TO COMPLEX PHENOMENA: AN ANALYSIS OF THE TURKISH DISASTER MANAGEMENT SYSTEM UNDER STRESS

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Submitted to the Graduate Faculty of

Public and International Affairs in partial fulfillment

of the requirements for the degree of

Doctor of Philosophy

University of Pittsburgh

2006

UNIVERSITY OF PITTSBURGH

GRADUATE SCHOOL OF PUBLIC AND INTERNATIONAL AFFAIRS

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University of Pittsburgh, 2006

This research analyzes and assesses the major issues regarding coordinated response operations in destructive earthquakes. The research examines the decision making process in the context of seismic risk to exemplify how public managers can utilize the information and communication systems in order to create collaborative actions in managing an extreme event.

Based on the theoretical framework from Complex Adaptive Systems and Socio-technical Systems, this study is an exploratory case study that explores the factors that hinder or facilitate coordinated response operations. This research applies the theoretical framework to the two earthquake response systems, the Marmara and Duzce that occurred in Turkey in August and November of 1999, respectively. This study investigated initial conditions of existing information infrastructure during the 1999 Marmara and Duzce response operations and compared the two response systems to discover whether the utilization of information and communication technologies significantly affected the performance of the Turkish disaster system. The findings of the study revealed that improving communication functions increased coordination activities thus eventually improved search and rescue operations from the Marmara to the Duzce earthquake.

This research conducts qualitative, quantitative and network analysis using data from content analysis of a national newspapers, *Cumhuriyet*, semi-structured interviews, archival records, professional reports, and official websites of disaster organizations. By using the data, the research also focuses on the period of review and redesign of emergency management policies and practices following the Marmara and Duzce earthquakes. It analyzes the changes introduced into the information infrastructure and organizational structure to evaluate to what extent the Turkish disaster management system possesses the characteristics of a socio-technical disaster system. Although the findings of the analyses showed that the initiations after the Marmara and Duzce earthquake, to some extent, improved the technical and organizational capacity of the Turkish disaster management system, the system still needs to be improved particularly at the local level to cope with a future destructive earthquake.

TABLE OF CONTENTS

LIST OF TABLES

LIST OF FIGURES

PREFACE

Dedication

To my sisters: Havva, Ahsen, and Zuleyha.

Acknowledgements

This dissertation would not be completed without help, support and encouragement from many people. I would like to first express my gratitude to Dr. Louise K. Comfort who has been my mentor since I joined the PhD program. I sincerely thank her for her advices, patience, and encouragement throughout my doctoral study. Without her intellectual, practical and editorial support, the completion of this research would not have been possible. I would also like to extend my gratitude to my dissertation committee members, Dr. Kevin Kearns, Dr. Siddharth Chandra, and Dr. Toni Carbo for providing many valuable comments that improved contents of this study.

My special thanks go to Dr. Ulvi Saran for helping me to get in touch with high level public bureaucrats in Turkey to conduct my interviews. I am also grateful to Sandra Monteverde for her incredible generosity for reading and editing my dissertation.

I thank my colleague and my dear friend, Sitki Corbacioglu for letting me use his data sources, and his sincere companionship. I am also thankful to Gultekin Kuyzu for his technical helps whenever I had questions about computer related issues.

I thank Muharrem Aktas for his long time friendship and invaluable assistance to arrange my dissertation in appropriate word and PDF format. His wife, Betul, and his son, Cihan, brought a great cheerfulness to my life when I need it most.

From enjoying the games of our soccer team, Fenerbahce, to long and joyful discussions, the friendship of Ramazan Basgut has been priceless to walk through the demanding journey of this dissertation. I also acknowledge Yakup Unlu, Galip Kiyakli, Ramazan Baldoken, Sami Basaran for their loyal friendship and genuine encouragement throughout my study.

My deepest gratitude goes to my parents, Nigmet, and Mustafa, for their love and dedication and the endless support for everything that I do. I also thank my siblings, my uncle's family, my grandma, and my aunts.

Last, I would like to thank my wife Belkis for her understanding, sacrifice and love during the final steps of my research. On March 6, 2006, I got the most beautiful gift of my life. The birth of my daughter, Zehra Selam, brought precious happiness to my life that lightened the difficulties at the very last stage of my dissertation journey.

1.0 INFORMATION PROCESSES IN DISASTER MANAGEMENT

1.1 MANAGING RISK IN EXTREME EVENTS

Public managers require different tools and implement different policies to address extreme events. Extreme events are rare, sudden occurrences that generate incredible consequences. Extreme events such as earthquakes disrupt the ordinary practices of public administration, and they pose complex, dynamic and unpredictable challenges to public managers. The complexity of such problems increases the need for interdependence and interconnectivity within an emergency response system and between the system and its environment. Effective response to these problems requires coordinated actions from multiple communities and organizations at different jurisdictional levels.

Public managers must create an appropriate fit between a nation's socio-technical system and its risk environment to coordinate disaster activities among emergency organizations. A socio-technical system can be defined as a system in which humans, computers, and organizations are integrated in an interactive system that exchanges, stores and acts on valid information from the environment (Comfort 2002b). Three elements are essential to create a successful socio-technical emergency management system. The first element is *technical structure* that establishes an information technology infrastructure to support the interactions among agencies engaged in emergency operations. The second element is *organizational* *flexibility* that depends on appropriate organizational design, structure, policies and procedures for a successful adaptation to changing conditions in disaster environments. The third element is *organizational culture* which reflects the degree of openness to and willingness to share, new information and to adapt new strategies (Comfort 1999). These three conditions determine the success of a self-adaptive socio-technical emergency management system under the dynamic environment of disasters.

The decision making process becomes extremely complex for responsible managers under the uncertain and dynamic conditions of disasters. Responsible decision makers from public, nonprofit and private sectors need timely, accurate information from all components of the disaster response system to coordinate actions among emergency organizations. The success of coordinated inter-organizational response operations depends heavily upon the ability of local communities to access valid, timely information and their capacity to search for, and exchange, this information in order to build a shared decision making process. Creating an interactive and participative culture within emergency organizations and between the organizations and their wider social environments is a fundamental requirement for proper decision making for inter-organizational response operations. Advanced information systems provide unique opportunities to support the decision making process by allowing emergency managers from all levels to search for, and exchange, information across disaster organizations. Understanding the potential of information systems and effective utilization of the information they provide contributes to reducing and preventing the substantial impacts of seismic risk. Could advanced information systems be used to develop an appropriate socio-technical system for coordinated activities in order to address the interdependent problems of disasters?

The purpose of this study is to define, and assess the major issues regarding coordinated response operations in emergencies. The study will investigate the decision making process in the context of seismic risk to demonstrate how public managers can adapt the information systems to manage an extreme event for a set of communities. The Marmara and Duzce Earthquakes which occurred in Turkey in August and November of 1999, respectively, are selected cases for this study.

The 1999 Marmara and Duzce earthquakes served as “a symmetry-shattering event” (Kiel 1994) that disrupted the established patterns of the Turkish Disaster Administration and created a need for redesigning a socio-technical emergency system that fits the risk environment more effectively. After the earthquakes, both authorities and citizens acknowledged the necessity of improvements in the socio-technical capacity of the system. In recognition of the need for change, the Turkish central government and the provinces of Istanbul, Sakarya, Kocaeli, Bursa, Yalova, Bolu, Duzce governments and municipalities, and various international organizations (*e.g.* World Bank) initiated various projects to implement information systems in order to increase the organizational and informational capacity of the Turkish disaster system.

This study will focus particularly on the period of review and redesign of emergency management policies and practices following the Marmara and Duzce Earthquakes. It will analyze the changes introduced into the information infrastructure following the earthquakes to evaluate the potential of utilizing information systems to support coordinated collective behavior among emergency organizations.

1.2 SEISMIC RISK IN TURKEY

Turkey is located in one of the most highly seismic regions of the world and has suffered remarkable losses of life and property due to earthquakes. Ninety-six percent of the land and 98% of the population are exposed to seismic risk (Turknet 2000). For thousands of years, a destructive earthquake has been occurring in Turkey in every 13 months. Turkey has also experienced other natural disasters which resulted in the loss of life and property of its inhabitants. Table 1 provides the percentage of destructive natural disasters occurring in Turkey from 1902 to 1999.

Table 1 Natural Disasters in Turkey (1902-1999)

Type of the Natural Disasters	**N**	**%**
Earthquake	131	61
Landslide	30	15
Flood	32	14
Rock falls	11	5
Fire	9	4
Avalanche, Storm, and Rain	2	1
Total	**215**	**100**

N=Number of Natural Disasters; %=Percentages of Natural Disasters
Source: Ergunay (1999, p.2)

According to information contained in Table 1, earthquakes are the most damaging and dangerous disasters affecting Turkey. Sixty-one percent of all recorded natural disasters in the last centuries have been earthquakes. Landslide and flood are the most significant types of other natural disasters, compromising 15% and 14%, respectively, of such occurrences.

Earthquakes are the most damaging and problematic type of natural disaster to significantly affect the social and economic life of Turkish communities. Table 2 measures the effect of earthquakes occurring in 1902-2005 in terms of the number of injuries and fatalities to persons and damage sustained to property (see Appendix B for the detailed data for earthquakes that occurred over for period 1902-2005).

Table 2 Destructive Consequences of Earthquakes, 1902-2005

Type of Consequences	**N**
Number of Earthquakes	145
Number of deaths	84171
Number of injured	72934
Number of damaged properties	799611
Annual Cost (% of GDP)	0.7

Sources: Adapted from Bogazici Universtiy Kandilli Observatory (www.koeri.boun.edu.tr), Earthquake Research Instittution National Earthquake Monitoring Center (www.angora.deprem.gov.tr), Prime Ministry Cirses Management Center (2000a, 2000b), Belgenet webpage (www.belgenet.deprem), Ergunay, 1999.

As indicated in the table, earthquakes killed 84,171 and injured 72,934 people, and damaged to 799,611 properties. On average, the annual cost of earthquake damage is 0.7% of Gross Domestic Product of Turkey. The impact of the Marmara Earthquake was estimated at 7% of the GDP on the Turkish economy in 1999 (Erdik 2000). The effects of earthquakes are not limited only to economic losses. For instance, the Marmara Earthquake hit the heartland of Turkey, impacting the economic, social and cultural life of the rest of the country. The loss of highly trained individuals also indirectly affects the communities' capacity building in the long run.

Scientists divide Turkey into six geographic parts characterized by active fault lines: the North Anatolian fault, the East Anatolian fault, the Aegean Graben System, the Hellenic-Cyprus Arc, the East Anatolian ConTRACtional Province, and Central Anatolian Ova Province (Demirtas and Yilmaz 1996). Among these fault lines, the North Anatolian fault line is the most active and has produced the mostly deadly earthquakes in the history of Turkey. These include the 1939 and 1992 Erzincan earthquakes and the Marmara and Duzce Earthquakes in 1999.

The North Anatolian fault line is one of the most seismically active and dangerous fault lines in the world. The most deadly earthquake that Turkey experienced in the twentieth century was the 1939 Erzincan earthquake that occurred on this fault line. The city of Erzincan suffered near total collapse and approximately 40 thousand people were killed. After the earthquake, several moderate and major earthquakes struck this fault line, including the 1999 Marmara and Duzce Earthquakes that killed 17,489 and 763 people, respectively.

The epicenter of the 17 August 1999 Marmara earthquake was located near the city of Golcuk in the Marmara region. The earthquake, Richter magnitude 7.4, caused significant damage in the provinces of Kocaeli, Adapazari, Yalova, Bursa, Duzce, Bolu, Istanbul, Zonguldak, Eskisehir. The Duzce earthquake occurred on the same fault line on 12 November 1999. The earthquake, Richter magnitude 7.2, affected mainly the city of Duzce and the province of Bolu. Both earthquakes had enormous impacts on the economic and social life of Turkey. The Marmara Earthquake was the most destructive disaster in the history of modern Turkey in terms of property loss. The exceptional consequences of this earthquake stem from the characteristics of the area where the earthquake occurred. This region is the heartland of Turkey in which two thirds of the population lives and more than half of the economic output of the nation is produced.

Even though Turkey has a high level of seismic risk, the Turkish disaster management system did not demonstrate sufficient administrative capacity to reduce the damage to the communities affected by these two earthquakes. The mismatch between the level of extreme, dynamic seismic risk and the information infrastructure of the Turkish disaster management system resulted in poor performance. The performance of response operations was criticized as uncoordinated and insufficient, especially following the Marmara Earthquake. Those criticisms are well documented. Many argued that the main issues directly impacting the performance of effective response operations included: (1) lack of availability of a valid knowledge base related to the risk area, (2) lack of a secure communication data network among disaster managers, and (3) lack of accessibility to information systems with sufficient information processing capacity (Gulkan 2000).

1.3 RESEARCH QUESTIONS

The study will address the following questions:

1. How effectively did the existing information infrastructure of the Turkish Disaster Management System support the organizational response operations in the 1999 Marmara and Duzce Earthquakes?
    a. What were the initial conditions of the information infrastructure before the earthquakes?
    b. To what extent did the existing information systems provide a knowledge base to support coordinated actions among emergency organizations from different jurisdictions?
    c. How did the existing information and communication technologies affect the interaction and exchange of information among emergency organizations during the disasters?
2. What factors restrain or facilitate information processes among emergency organizations from different organizational and jurisdictional levels?

a. What internal and external factors create opportunities or deficiencies for better information exchange among organizations in the disaster management system?
b. To what extent do these initial conditions of the information infrastructure need to support the organizational structure in order to coordinate response to the disaster?
c. To what extent is it necessary for the organizational culture to support openness to new information?

3. How could advanced information systems be used to improve the performance of the Turkish disaster management system?

a. To what extent has the Turkish disaster management system become a socio-technical system?
b. What changes in the organizational structure of the Turkish disaster management system, if any, have been made after the earthquakes?
c. What changes in the technical information structure, if any, have been made, and at what governmental levels, since the 1999 earthquakes?
d. To what extent are the developments in the information infrastructure after the earthquakes compliant with changes in the organizational structure?
e. What changes, if any, can help to create a better fit between Turkey's socio-technical infrastructure and the unpredictable and dynamic problem of seismic risk to which it is exposed?

1.4 RESEARCH OBJECTIVES

The study aims to accomplish the following objectives. They are:

1. Identify the role of information and communication technologies in facilitating or hindering the interactions among emergency response operations during the earthquakes;
2. Examine the existing technical and organizational capacity of the Turkish disaster management system in order to understand the gaps in information processes across emergency organizations during the disasters;
3. Investigate the attempts to construct a new information infrastructure after 1999 and determine whether these efforts are in accordance with changes in organizational structure; and,
4. Evaluate the new state of Turkish disaster management from criteria defined for a "socio-technical" approach.

1.5 SIGNIFICANCE OF THE STUDY

This study is significant for several reasons, both theoretical and practical. First, it shows the utility of an emerging model in organizational theory. Conventional organizational models, rational, natural and open systems (Scott 1992), in organization theory are not adequate to explain the complex problems of communities. This study indicates that under dynamic, uncertain, nonlinear conditions, traditional command-control models fail to achieve organizational objectives. The study of a disaster management system illustrates how a complex adaptive organizational system model could serve as an alternative way to address extreme, sudden events for communities.

Second, the study examines the application of advanced information technologies to public management problems. Many scholars (Simon 1969; Goodman, Sproull, and Associates, 1990; Fountain 2001; Hoschka 1996; Coovert 2001; Comfort 2002a; Coakes 2003) have focused on the uses of information technologies in societal organizations. These studies examine how technology could be used to enhance the capacity of responsible decision-makers in managing interdependent social problems. From this perspective, this study documents the primary characteristics of "socio-technical systems" where information systems and human beings are integrated to overcome the consequences of rapid shifts in the physical and policy environments.

Third, this study has a practical application as well. Earthquakes create an enormous risk to human life and material sources of the communities in Turkey. The Marmara earthquake alone caused $16 billion in damage, approximately 7% of the GDP of Turkey (Comfort and Sungu 2001). Addressing this problem systematically would not only contribute to saving many lives, but also would protect the assets of the nation. After the 1999 earthquakes, Turkey began to seek, and establish, a system that best minimizes the harmful consequences of natural disasters. Efforts have mainly focused on increasing the information capacity of the system for coordinating disaster activities. At the same time, there have been efforts to alter existing organizational policies and structures. This study analyzes the implementation of information systems into the disaster management system as a primary step in Turkey's continuing efforts to manage seismic risk.

1.6 PRESENTATION OF THE STUDY

This dissertation contains nine chapters. Chapter 1 presented the study by defining the problem statement, the research questions, and the research objectives. Chapter 2 presents the theoretical background and conceptual framework on which the study is based. Chapter 3 presents the research methodology and research design. Chapter 4 provides information regarding changes in the Turkish disaster policy and management structure.

Chapters 5 and 6 investigate the initial conditions of information infrastructure and the inter-organizational coordination during the 1999 earthquake response operations. In Chapter 5, I use interview data to explore the initial conditions of information infrastructure and compare the performance of the Turkish disaster system in both response operations. In Chapter 6, I use content analysis of a national newspaper, *Cumhuriyet*, to investigate organizational interactions to evaluate how information and communication capacity of the disaster organizations affected inter-organizational coordination during response operations.

Chapter 7 presents joint projects developed after the 1999 earthquakes to increase the organizational and informational capacity of the Turkish disaster system. Chapter 8 provides information on the current state of information infrastructure, local sustainability of the disaster system, and the level of organizational flexibility to identify how changes after earthquakes increased mitigation capacity of the system to be ready for future destructive earthquakes.

2.0 TOWARD SOCIO-TECHNICAL DISASTER MANAGEMENT SYSTEMS

2.1 INTRODUCTION

This chapter presents the theoretical background and conceptual framework of the study. Increasing complexity and uncertainty in today's dynamic, rapidly changing environments require a new understanding of disaster management. Shifting from conventional management strategies to new strategies and increasing local capacity to create disaster resilient communities are important aspects of a proposed disaster management system. Progress in the science of complexity and advanced information systems has brought new opportunities to redesign the public sector to cope with natural and artificial disasters threatening the life of communities. This chapter briefly summarizes the basic functions of Complex Adaptive Systems and the characteristics of Socio-Technical Systems for a more appropriate disaster management structure.

2.2 DISASTER MANAGEMENT IN TRANSITION

As in many areas of public management, conventional planning models in disaster management are based upon linear assumptions. According to linear assumptions, policy actions in public management not only produce desired outcomes, but also these actions and outcomes are proportionate. In this model, an analytical approach to address the problem is: "study the problem, develop alternatives, choose one, and move on to the next problem" (Mileti 1999, 146). Organizations work like machines, contain standard operating procedures and formal rules that identify responsibilities and ensure that all these procedures are reliably performed (Scott 1992; Morgan 1997). These organizations can be very effective where the environment is stable, problems are well-defined, and organizations can be closed to outside interference. However, in uncertain and complex environments, those machine-like organizations are likely to fail to achieve desired goals (Osborne and Gabler 1992; Marion 1996; Barzelay 1992; Comfort 1999; Axelrod and Cohen 1999).

In a traditional disaster management system, managers in a centralized system are more concerned with the intention to reduce risk and assume that execution of this intention and application of existing knowledge will result in proportional advances in hazard reduction (Turner and Pidgeon 1997, 4; Mileti 1999, 146). However, disasters create different norms, "emerging norms," from regular norms (Schneider 1995). The discrepancy between "emerging norms of disasters" and "bureaucratic norms of disaster administration" represents failures of intention (Schneider 1995). The goal of a disaster management system is to find ways of diminishing this discrepancy to deal with the fatal consequences of disasters. A process-oriented, decentralized, flexible disaster management system with long-term mitigation plans is more likely to meet the emerging characteristics of disasters.

2.2.1 Shift from Disaster Response to Disaster Mitigation

Scholars generally agree that there are four different cycles in disaster management activities: preparedness, response, recovery and mitigation (Mileti 1999; Comfort 1999; Schneider 1995).

A traditional disaster management approach is more concerned with response actions. Managers take action after a disaster happens. Balamir (1999) calls this type of administration "State as Healer." According to Balamir (2001), the main goal of the "healer state" is to save lives rather than to protect them. Balamir calls it a "fatalistic society" with the attributes of "saving strategy," "organizational frustrations," "healing discourse," and "crisis planning" (Figure 1).

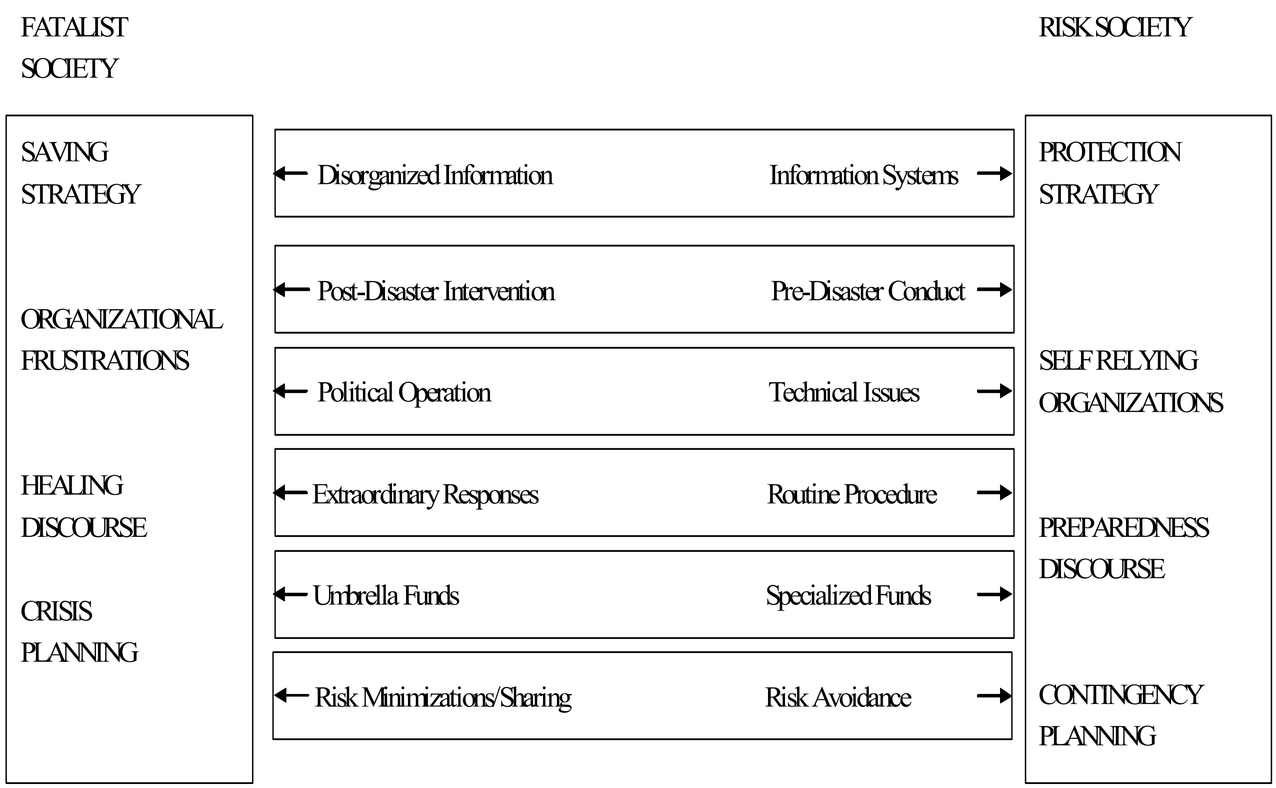

Figure 1 The Attributes of Fatalist and Risk Society (adapted from Balamir 2001)

On the opposite side of this model is the concept of a risk society (Balamir 2001). Balamir's risk society is a "disaster resilient community" that is aware of future disasters and has a sustainable network of physical systems and communities to withstand an extreme event without experiencing devastating losses (Mileti 1999). A risk society pays more attention to the mitigation process that aims to reduce the vulnerability of a community to damage from future disasters (Schneider 1995). "Protecting strategy," "self-relying organizations," "preparedness discourse," and "contingency planning" are the main characteristics of this model (Balamir 2001). Moving from a fatalistic society model to a risk society model would not only reduce the vulnerability of communities and save more lives, but also would be more cost effective.

2.2.2 Local Government

Although local communities are more vulnerable to disasters, traditional disaster management systems put relatively less emphasis on improving the local capacity of the system. Human and material resources and the authority to mobilize these resources are often gathered at the national level. In many administrations, this appears to be a fundamental power issue between central and local organizations of the system. As Pfeffer (1992) states, every organization involves politics. The main sources of power in organizations, according to Pfeffer, are having resources, being in the center of a communication network, implementing important tasks, and having the capacity to seek and hold information. Thus, managers at the central level are more likely to have power and are not willing to share it with local managers. This creates serious difficulties with respect to disaster management.

The centralized system performs slowly and nonflexibly to overcome damage from disasters during sudden disruptions. The key resolution to these problems is to foster local sustainability (Mileti 1999). "Sustainability refers to the capability of complex systems…to cope with changing conditions, to permanently adapt and, nevertheless, satisfy present needs" (Possekel 1999, 56). From this point of view, local sustainability represents a system where "a locality can tolerate and overcome damage, diminished productivity, and reduced quality of life from an extreme event without significant outside assistance" (Mileti 1999,4). Therefore, to accomplish local sustainability, local governments and local residents should have more power and should take more responsibility for evaluating and allocating the resources, and designing the policies to reduce the impacts of disasters (Platt 1999; Mileti 1999).

The performance of a disaster management system depends on the system's capacity at the local level. Local conditions represent the initial conditions of the system, govern the whole disaster system, and eventually generate and characterize the choices for policies at different stages of disaster management. This requires an effective link between central actors and local actors. It is crucial to include local perspectives into the policymaking process to diminish disaster risk. Increasing the capacity of local components of the system improves the performance of the system. In a successful disaster management system, local governments and communities are more involved in systems dealing with future disasters.

2.3 COMPLEX ADAPTIVE SYSTEMS

Interdependent characteristics of the policy environment clearly show that a classic bureaucratic organization of the system is not able to provide the unity, complexity and selectivity required for survival (Bennet, A. and Bennet, D. 2000). A new model is needed to design an organizational system that best represents the complex characteristics of a changing organizational world.

2.3.1 Complexity and Nonlinearity

Complexity refers to the emergence, development and evolution of new structures and patterns. Prigogine (1980) states that emerging complexity is a transition from being to becoming.

Complexity arises from the inter-relationships and inter-connectivity of elements within a system and between a system and its environment. Emerging complex systems are composed of "context-dependent interactions," and "these interactions, and the resulting system, are nonlinear" (Holland 1998, 121-122). The sequence of the problems is characterized by changing patterns, which rarely repeat themselves. They are all sensitive to initial conditions, situational context, and external forces (Lewin 1992; Gell-Mann 1994). A small discrepancy in the initial conditions can result in completely unexpected outcomes.

A disaster response system illustrates a good example of a nonlinear complex system. A disaster produces unpredictable consequences that require abrupt changes in reallocation of resources in a limited time period. The unexpected consequences may also create changes in the exercise of authority in the system to meet the demands of new environment. The system's ability to manage these changes depends on the flexibility of the system in adapting to the new environment. The velocity of information absorption and the level of willingness to share information among the components determine the adaptability of the system to unpredictable sudden changes in the environment. The success of disaster management policies depends upon the degree of information that policy makers acquire from and share with others.

2.3.2 Complexity and Uncertainty

The theory of complexity deals with "dynamic processes, transformations, and sudden changes which are not the exception, but the rule in the continuous becoming of a non-linear system" (Possekel 1999, 50). The important consequence of those dynamic processes and transformations is uncertainty which directly affects the course of actions (Comfort 1994). Uncertainty arises from the lack of adequate information necessary to perform the tasks, and from the scarcity of information about the operational environment. From this uncertainty, it may be possible to anticipate future events; however, it is not likely to be able to estimate the probability, consequences, or time when events might happen (Possekel 1999, 23). The unanticipated consequences of future problems make the decision-making process more difficult (Uri 1995; Comfort 1999; Scott 1992; Bolman and Deal 1997).

People use different strategies to deal with uncertainty (Dovers and Handmer 1992). According to Dovers and Handmer, some people are opposed to any change and try to avoid those that threaten existing institutional structures. Some accept selected changes in selected subjects and allow gradual changes which do not alter fundamental values and structures. Finally, there are others who are open to new ideas and are flexible and adaptable. They do not object to new conditions that challenge the basic institutional values and structures. They are ready to move in a different direction to cope with unpredictable circumstances. Wildavsky (1988) calls this characteristic “resilience”.

Wildavsky (1998) defines two types of behaviors that people use to eliminate the risks of uncertainty: anticipation and resilience. In the first type of behavior, people design their policies and institutions based on the anticipation of the possible risks and how to avoid them. They select predictable and secure activities to control the risk and to diminish their negative effects.

In contrast, other people prefer resilience as a strategy to cope with uncertainty. These people consciously accept risks and design their actions based on this premise. This type of behavior (resilience) is capable of accepting uncertainty and of responding flexibly to changing conditions. Open information and communication channels that enable information flow among actors are important to support resilient patterns of behaviors. The way to deal with this uncertainty is to increase the capacity of the systems for obtaining, storing, and exchanging information about the past and present circumstances in order to deal with the possible outcomes of future problems. This information gathering has to be acquired in a continuous learning process, which maintains the system's capability to adapt whenever necessary (Possekel 1999, p. 49).

2.3.3 Complex Adaptive Systems

Borrowing from evolutionary biology (Kauffman 1993), recent theorists in organization theory have emphasized Complex Adaptive Systems (CAS) (Holland 1995; Comfort 1999; Axelrod and Cohen 1999; Stacey 2000, 2001) as an appropriate model to meet the demand of complexities in a dynamic societal environment. CAS theory considers systems as living organisms consisting of living subsystems that merge and interact to provide the capabilities of an advanced adaptability. The operation of the whole system depends on the well-functioning of the parts, although the whole is more than the sum of its parts. These systems are composed of self-organizing subunits that seek to maximize their own benefit, but at the same time act according to general system rules and in the context of interactions with other components and the external environment (Bennet, A. and Bennet, D. 2000).

Four characteristics of Complex Adaptive Systems are recognized as fundamental (Kauffman 1993; Prigogine and Stengers 1984; Kiel 1994; Gell-Mann 1994; Comfort 1994; Nicolis and Prigogine 1989). They are:

1. CAS are very sensitive to initial conditions;
2. CAS are vulnerable to random events which may affect significantly the performance of parts of the system;
3. CAS have a potential for self organization;

4. Performance of CAS depends on information flow among different components of the whole system.

A complex adaptive system is composed of interacting agents seeking to achieve a common goal (Cohen and Axelrod 1999, 153). The interaction of agents at the micro level determines the macro level behavior of the system. The competing strategies used by the component agents attempt to draw the macro level entity, the system, to behave in a particular way. It is the dominant strategy that determines how the system behaves. The nature of the interaction among agents and the system's sensitivity to initial conditions generates performance adaptive to a changing environment rather than a linear relationship that produces the same behavior every time (Holland 1995; Kauffman 1993; Morel and Rangaraj 1999).

Complexity researchers show that CAS exist and operate in the range of action between pure stability and complete instability, called “the edge of chaos” (Stacey 2000; Kauffman 1993). On a continuum ranging from chaos to order, the edge of chaos lies in the middle. At the edge of chaos, “the system has its best capacity for the processing of energy and information and is thus capable of optimizing its fitness” (Possekel 1999, 19). This is the state where the system is able to be creative and innovative, while at the same time maintaining its identity and unity (Stacy 2000). This state can be achieved only when information flow and connectivity among components (agents or workers) are achieved (Stacey 2000; Comfort 1999). Information flow and the connectivity of components are positively related. In order to increase connectivity that promotes the collective behaviors of subunits, the communication channels fostering information flow should be open. Creating these communication channels is a major task for system designers.

2.3.4 CAS and Disaster Management

In disaster environments, three different systems, "the earth's physical systems," "human systems," and "the constructed systems," interact dynamically (Mileti 1999). Increases in the size and complexity of human and constructed systems in a given physical environment, for example, growing urbanization in a disaster prone area, increases the risk and makes disaster problems more difficult to solve (Mitchell 1999; Mileti 1999).

A disaster management system is a good illustration of CAS in practice, as many interacting organizational elements create complexity. Disaster management systems operate at central, provincial and local jurisdictions simultaneously. Public, private, nonprofit, and international organizations interact and collectively respond to natural disasters. The behavior and interaction among these organizations from different jurisdictions determine the success and effectiveness of the entire disaster management system. In such a complex system, acquiring and exchanging the relevant information among multiple emergency organizations from different jurisdictions is vital. If a subunit of the system fails to attain and transmit the required information, the whole system will likely fail to adapt to the requirements of the risk environments in which they operate. The success of the whole system is associated with the quantity and quality of information that flows among the connected units. This information is necessary for coordinated operations across emergency organizations.

2.4 SOCIO-TECHNICAL SYSTEMS AND SELF ORGANIZATION

The development of socio-technical system approaches can be traced to the 1950s (Coakes 2002) and is based on the fundamental idea that organizations are open systems (Katz and Kahn 1996). Socio-technical systems refer to “the study of the relationships and interrelationships between the social and technical parts of any system” (Coakes 2002, 5). In such a system, the technology, human actors and organizations are all interdependent (Checkland 1981, 256).

2.4.1 Technology and Organizations

Up to the 1990s, scholars studied the relationship between technology and organizations in many aspects, exploring technology as a physical element of an organization (Thomson 1967; Woodward 1965; Scott 1992); or technology as a manufacturing tool which increases productivity and economic benefit (Schonberger 1986; Mokyr 1990). The early studies of technology in organizations mostly focused on “task allocation” between machines and human actors. Herbert Simon’s pioneering book (1969, 1981), *The Sciences of Artificial*, captured postindustrial development and offered a new way to look at the relationship between technology and organizations.

Simon argued that like technology, organizations and administrations are also artificial, or man-made. Unlike natural phenomena, “artificial phenomena have an air of contingency in their flexibility by environment” (Simon 1969, preface). He claims that organizational systems, or entities, are "artificial" in the sense that they are contingent upon the goals of their designer. He sees technology, especially computers, as a stimulus, a source of knowledge, to assist human managers in the decision making process. From this perspective, the manager can utilize technology, as a means to manage, change and redesign organizations.

2.4.2 IT and Socio-technical Systems

Since the 1990s, remarkable developments in information technologies (IT) have added new, fresh viewpoints to the study of socio-technical systems. IT can be described as the means by which the acquisition, storage, and dissemination of information using computers can be accomplished easily and rapidly (Coakes 2003; Maglitta 1996). This development moved the relationship between technology and organizations in different directions. Many scholars studied IT as a complementary means of support to human beings in organizations, and considered it to be a revolutionizing tool that alters the way of working and administrating. According to these scholars, IT can increase individual and group skills that enhance collaborative work (Coovert and Thompson 2001). IT collapses the barriers of time and distance (Fountain 2001), eventually altering the regulation of authority between central and local units within systems. IT can also assist managers to develop models of problems and solutions, and to identify inconsistencies between a model and practice (Hoschka 1996), which can help to decrease the discrepancy between design and policies. More importantly, IT has created the means to facilitate the sharing of information among various subunits by offering the advantage of instantaneous access to relevant information (Malhotra 2000). The important outcome of this sharing of information is the establishment of a knowledge base for more suitable future actions.

Developments in IT have brought new opportunities to design socio-technical systems as network organizations. According to the human view of network organizations, computerized technology created a system in which workers are connected to one another to exchange information and other resources easily (Sproull and Kiesler 1991). These network organizations enhance communication across social groups that allow free expression of thoughts, and increase the level of openness to changes. With the application of IT, socio-technical systems are capable of supporting networks of communication among subunits of an organization. This interaction increases the information exchange across the system, improving organizational capability to make decisions for quick actions.

There are five components of a socio-technical model: people, tasks, technology, structure and the environment within which an organization operates (Laudon and Laudon 2000). These five components of the system are closely connected and affect each other (Figure 2). The appropriateness of fitness among these parts determines the success of the system. The interactions among the components go through continuous change. A process of continuous learning is required and can be supported by information systems throughout the progress.

A socio-technical design is more appropriate for conditions of uncertainty, dynamic change, and complexity, where timely, relevant and accurate information is required for continuous efforts to adapt to changing parameters of environments. “The goal of social technical design is to produce a system capable of self-modification, of adapting to change, and of making the most of creating capabilities of individuals for the benefit of the organization” Coakes 2002 , 6).

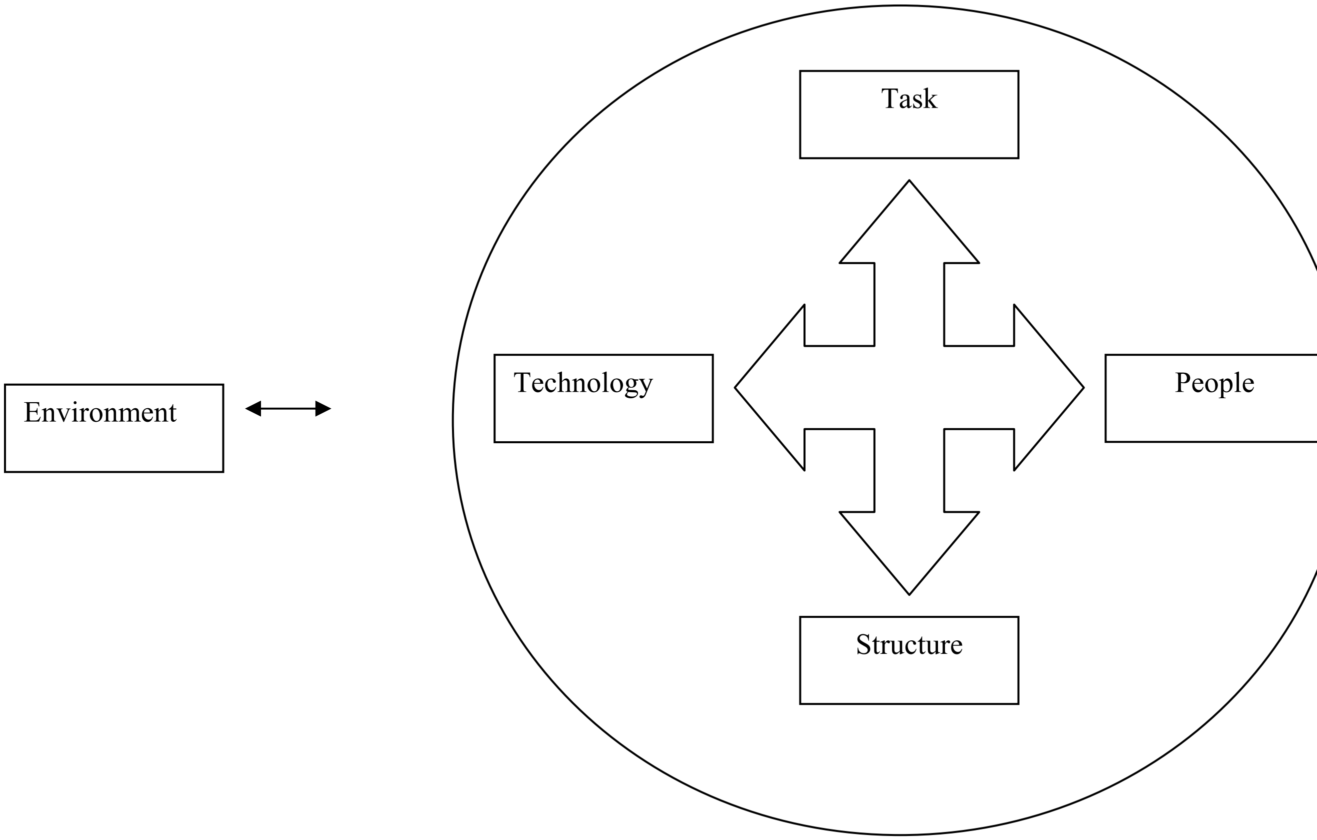

Figure 2. The five components of socio-technical system (Laudon and Laudon, 2000)

An important characteristic of socio-technical designs involves "the use of feedback loops, and participation" (Bancroft 1992, 94). The flexible organizational structure of these systems enables policy makers to learn from their mistakes by providing feedback on actions so that they could alter the underlying assumptions of the strategy of their actions (Argyris 1993; Argyris and Schon 1996). In that respect, organizational culture appears to be an important concept to which responsible managers should pay attention in order to raise the capacity of organizational learning.

2.4.3 Organizational Culture and Socio-technical Systems

Organizational culture can affect the functionality of organizational systems. In a successful system, the institutional culture should encourage individuals to share information with others. People who are accustomed to work under conventional hierarchical authority tend to resist new ideas and are not habitually willing to share information. A socio-technical model has an advantage over other models by providing an information-rich environment in which individuals have more opportunity to learn from others.

Human beings understand, interpret, and act on meanings derived from information (Goodman, Sproull, and Associates 1990; Malhotra 2000; Coakes 2003). Understanding the organizational and social environments in which people make sense of their surroundings (Weick 1990; Weick 1995) is important in designing a successful socio-technical system. Hence, managing change and implementing a socio-technical design requires an understanding of organizational and social culture (Bancroft 1992; Comfort 1999). A successful socio-technical design should be supported by an organizational culture that facilitates "openness to new information" (Comfort 1999). Therefore, training appears to be a key factor that enables employees to process the information and manage the knowledge needed for effective action. It is essential to create an environment that supports information exchange.

2.4.4 Socio-technical Systems and Disaster Management

To understand the problems that a disaster produces, it is useful to envision a disaster as a socio-technical problem in which social, organizational and technical processes interact in a dynamic manner (Turner and Pidgeon 1997, 3). Disasters need to be placed in "the context of the social setting from which they emerge, and upon which, in their turn, they have an effect" (Turner and Pidgeon 1997, 25), so that designs, plans, policies and implementation will be corresponding.

In a disaster environment, many individuals representing multiple organizations interact under very dynamic conditions. These individuals with different skills, capability, responsibility, and ability to access information interact under very dynamic conditions. Their interactions must be harmonized for coordinated operations. To achieve this coordination, it is necessary for public managers to build an information infrastructure which diminishes the discrepancy among responsible disaster managers in accessing valid, timely information and increases the capacity of actors to search for, and exchange, information (Comfort 2002b). This discrepancy can be minimized by implementing a socio-technical system to support disaster management.

In a socio-technical disaster management system, IT becomes an agent allowing disaster managers to access relevant information easily and quickly as a basis for their strategy of actions (Comfort and Sungu 2001). In such systems, individual organizations can be aware of the system level goals to produce creative solutions without seeing the other subunits as separate entities from the whole. The success of this spontaneous and rapid adaptation depends upon a multi-way communication network that supplies timely and accurate information. By supporting flexible management structures, socio-technical systems are able to meet technical and organizational requirements to respond to the rapidly changing disaster circumstances.

2.5 CONCEPTUAL MODEL

The preceding theoretical discussion provides a preliminary model that will guide this research. The main assumptions of the model are:

1. A disaster response system possesses dynamic, unpredictable, and complex characteristics. The complexity arises from numerous interactions among components within the organizational system and its environment. The success of the system depends on the level of connectedness of the parts and the adaptability of the whole system to changing conditions in the environment in which the system operates.
2. The fundamental characteristics of a disaster management system need to match the dynamic and uncertain characteristics of disaster environments. The initial conditions of organizational and informational capacity of a disaster system influence its performance in an actual event.
3. The socio-technical system represents a model for disaster systems. Disasters create turbulent and complex conditions that require access to valid and timely information. Therefore, a disaster management system must possess sufficient flexibility through decentralization and lateral coordination to accommodate information search, exchange and organizational learning.
4. Sufficient and timely information processing requires utilization of the necessary information infrastructure. Increasing information capacity through the information infrastructure increases information search, exchange, and feedback within a system, and between the system and its environment.
5. Improving organizational and informational capacity of local disaster organizations increases information flow, enabling responsible decision makers from different

jurisdictions to make timely and effective decisions. Timely and effective decisions based on continual organizational interactions increase coordination between organizations. Thus, well-coordinated operations will save more lives and reduce the cost of disasters to communities.

2.6 SUMMARY

This chapter reviewed the literature to provide a theoretical background for the development of a socio-technical disaster management system. In the first part, the chapter reviewed characteristics of the traditional disaster system. This review exposed the inability of the bureaucratic, centralized traditional system to cope with problems of seismic risk. The system should pay more attention to mitigation efforts and increase the capacity of local communities to avoid the destructive consequences of earthquakes.

This chapter then reviewed literature of complex adaptive systems. The characteristics of complex adaptive systems offer a model for dynamic, uncertain, and complex disaster response systems. To establish this model, the components of whole disaster system should be well inter-connected to act simultaneously and to adapt rapidly to changes in the disaster environment. Therefore, information flow among the components of the system becomes crucial. The goal of responsible managers in disaster organizations is to create an environment in which technology, human beings and organizational structure allow adequate information flow among disaster agencies. The third section of the chapter analyzes this issue and proposes that the disaster system should be established in the form of the socio-technical system by utilizing the benefit of advanced information and communication systems. Finally, in the light of these theoretical explanations, the chapter includes a conceptual framework upon which this study based.

3.0 AN EXPLORATORY CASE STUDY: CONCEPTS AND METHODS

3.1 INTRODUCTION

This chapter presents the research design and methods, selection of cases, validity and reliability of the research, sampling design, unit of analysis and observations, research questions and research assumptions, data sources, processes of data collection, and data analysis and interpretation.

3.2 RESEARCH METHOD

3.2.1 An Exploratory Case Study

A case study method will be used to explore the dynamic, nonlinear characteristics of the Turkish disaster management system. A case study is considered an appropriate methodology when a researcher conducts a detailed investigation of a particular problem (Feagin, Orum, and Sjoberg 1991). When a research problem is not yet clearly structured, it is essential to investigate a comprehensive profile of its components and their interactions that shape the circumstances for a more accurate research design (Yin 1993, 1994; Comfort 1999). A case study is designed to reveal details from the viewpoints of participants by utilizing multiple sources of data (Tellis 1997a).

I used the preliminary conceptual framework to conduct the research. The preliminary theoretical framework is critical for conducting an exploratory case study. The framework and its propositions guide the research and are completed after conducting the study. It is important to analyze the case consistent with the theoretical model and the objectives of study. In view of the complex and dynamic characteristics of the study on the developments of the Turkish disaster system after 1999 earthquakes, an exploratory case study appears the most appropriate research methodology.

3.2.2 Validity and Reliability

As in all research, the exploratory case research method must take construct validity, internal validity, external validity and reliability into consideration (Yin 1989). Using multiple sources of data will ensure construct validity (Yin 1994). I used official documents, content analysis of a national newspaper, interviews, professional reports, and data collected from field observations. These multiple sources of evidence assist me to ensure construct validity.

A threat to internal validity may occur in evaluating the impact of changes introduced in the organizational and informational structure of the Turkish disaster management system after the 1999 earthquakes. To avoid this threat, the evaluations are based on the conceptual framework which directs the whole study.

External validity is a generalization issue. Are the findings applicable to other cases, or are they solely applicable to certain time periods in certain regions? This question raises issues for threats to external validity of the research. Yin (1984) answers the widespread criticism of the case study method that the findings are not widely valid in real life experience. Yin makes a distinction between statistical generalization and analytic generalization. Yin (1984) asserts that previously established theory is used as a model against which to compare the empirical outcomes of the case study in analytic generalization. Therefore, external validity can be attained from these theoretical relationships, and generalizations can be made (Yin 1994). The theoretical background and framework ensure external validity for this study.

Consistency in the whole research process and preliminary procedure prepared to conduct this study ensure reliability of the research. The research questions, assumptions, sources of data, data collection process, data analysis, techniques used for this analysis are developed in advance to ensure the reliability of the research.

3.2.3 Selection of Cases

This study of the Turkish disaster management system represents a case in which two sequential disaster events, the 1999 Marmara and Duzce earthquakes, precipitated significant changes. These disasters were severe tragedies that tested the awareness of seismic risk in Turkey. After the events, Turkish citizens and public managers acknowledged the need to make transformations to cope with continuing seismic risk. Turkish public administration has sought to implement significant changes in organizational structure and informational infrastructure since the earthquakes. Second, these symmetry breaking events created an environment in which many interactions among disaster organizations from different jurisdictions created unique opportunities to observe the characteristics of a complex adaptive disaster management system.

The study will examine information processes during disaster operations as a baseline for investigating the changes made in information infrastructure and policies after the 1999 earthquakes.

3.2.4 Unit of Analysis and Unit of Observations

The unit of analysis for this study is the organization. The unit of analysis is an important issue in the exploratory case study. Determining the unit of analysis relies on the initial questions of the research (Yin 2003). The unit of analysis is not an individual or group of individuals, but rather it is a system of action being examined (Tellis 1997b).

Organizations are collective actions of individuals and individuals, on the other hand, act as components of organizations to adapt to changing conditions of environments (Scott 1992; Argyris & Schon 1996). Each responsible decision maker is a component of her organization and is thus representative of the organization. Therefore, the unit of observation in this study is the responsible decision maker in disaster agencies involved in the Turkish disaster response system.

This study examines the dynamic characteristics of interactions among disaster organizations in the Turkish disaster management system. It examines the whole Turkish disaster management system, which consists of a set of interrelated organizations at the national, provincial and local levels. The goal of this analysis is to examine the role of information systems in relation to patterns of interactions within and between disaster organizations. This research examines organizational and system level developments in the Turkish disaster system through interviews with responsible managers involved in the 1999 response operations and disaster mitigation efforts, following the 1999 earthquakes.

3.3 RESEARCH QUESTIONS, OBJECTIVES, NEEDED INFORMATION, AND SOURCES OF INFORMATION

3.3.1 Research Questions and Objectives

This study seeks answers to three primary questions that have detailed sub-questions. These research questions aim to achieve the objectives of the study. Table 3 presents the objectives and the questions posed to reach these primary objectives.

Table 3 Research Questions and Research Objectives

Primary Research Questions	Sub-Research Questions	Research Objectives
1. How effectively did the existing information infrastructure of the Turkish Disaster Management System support the organizational response operations in the Marmara and Duzce Earthquakes?	1.1. What were the initial conditions of the information infrastructure before the earthquakes? 1.2. To what extent did the existing information systems provide a knowledge base to support coordinated actions among emergency organizations from different jurisdictions? 1.3. How did the existing information and communication technologies affect the interaction and exchange of information among emergency organizations during the disasters?	1. Identify the role of information and communication technologies in facilitating or hindering the interactions among emergency response operations during the earthquakes
2. What factors restrain or facilitate information processes among emergency organizations at different organizational and jurisdictional levels?	2.1 What internal and external factors create opportunities or deficiencies for information exchange among organizations in the disaster management system? 2.2 To what extent are these initial conditions of information infrastructure, along with organizational structure, sufficient to facilitate information processes in the decision making process to respond properly to the disasters?	1. Identify the role of information and communication technologies in facilitating or hindering the interactions among emergency response operations during the earthquakes 2. Examine the existing technical and organizational capacity of Turkish disaster management system in order to understand the gaps in information processes across

Primary Research Questions	Sub-Research Questions	Research Objectives
	2.3 To what extent does organizational culture support openness to new information?	emergency organizations during the disasters 4. Evaluate the new state of Turkish disaster management from criteria defined for a “socio-technical” approach
3. How could advanced information systems be used to improve the performance of the Turkish disaster management system?	3.1 To what extent has the Turkish disaster management system become a socio-technical system? 3.2 What changes in organizational structure, if any, have been made after the earthquakes? 3.3 What changes in technical information structure, if any, have been made at what governmental levels since the 1999 earthquakes? 3.4 To what extent are the developments in information infrastructure after the earthquakes compliant with changes in organizational structure? 3.5 What are the opportunities which can help to create a better fit between Turkey’s socio-technical infrastructure and the unpredictable and dynamic problem to which it is exposed?	3. To investigate the attempts in constructing a new information infrastructure after 1999 and determining whether these efforts are in accordance with changes in organizational structure 4. To evaluate the new state of Turkish disaster management from the viewpoint of “socio-technical” approach

3.4 DATA COLLECTION

3.4.1 Primary Data Sources

Five types of data will be used for this study. They are:

1. Field observations of disaster sites previously conducted, and operating environments of disaster organizations;
2. Review of official documents, professional reports, archival records, and news analyses;

3. Content analyses from a national newspaper, *Cumhuriyet*[1], for 21 days following the 1999 Marmara and Duzce earthquakes, respectively[2];
4. 58 semi-structured interviews with selected decision makers from public, private, and nonprofit institutions;
5. Content analyses of weekly news reports from a national newspaper, *Cumhuriyet*. *Cumhuriyet* publishes an additional section called “Science and Technology” every Saturday. The web-site of *Cumhuriyet* permitted me to search the archives of the Science of Technology section from May 1998 to May 2005. I collected data to obtain information about the projects and changes in informational and organizational structure after the 1999 earthquakes;
6. Official web-sites of disaster agencies.

3.4.2 Data Collection Process

I followed five basic steps for the data collection.

1. I identified the primary organizations involved in the 1999 disaster response operations using content analyses of *Cumhuriyet* for 21 days following the earthquakes.
2. I identified the primary organizations involved in the projects established to increase the organizational and informational capacity of the Turkish disaster response system after the 1999 earthquakes by using weekly news reports, and professional reports.

[1] Cumhuriyet is a national newspaper published in Istanbul.
[2] The content analysis was conducted by Sitki Corbacioglu (Corbacioglu, 2004). I used the raw data from his content analysis of *Cumhuriyet* for the Marmara and Duzce earthquakes to identify disaster agencies involved in response operations and to establish a representative sample for interviews. I also used the data set for the network analysis to determine the characteristics of response systems and the type of transactions and interactions among disaster agencies.

3. I constructed a stratified representative sample of key organizations involved in the response systems and the mitigation projects.
4. I conducted 58 semi-structured interviews with 39 key decision makers from this sample of key organizations.
5. I collected archival data, professional reports, and official documents in reference to the organizations and processes involved in developing information infrastructure.

3.4.3 Needed Information and Sources of Information

Data gathered from different sources are used to address the questions of the study. Table 4 presents the needed information and the sources of this information to answer the major questions of the research.

Table 4 Research Questions and Data Sources

Research Questions	Needed Information	Data Sources
1. How effectively did the existing information infrastructure of the Turkish Disaster Management System support the organizational response operations in the Marmara and Duzce Earthquakes?	• roles of organizations involved in disaster operations, • interaction patterns among organizations • type of IT used • role of shared knowledge bases effectiveness of disaster operations	• Interviews (Q2-Q8) • situation reports • *Cumhuriyet* content analysis • official documents • post-disaster critiques • professional notes • archival data
2. What factors restrain or facilitate information processes among emergency organizations from different organizational and jurisdictional levels?	• Internal and external factors affecting information sharing • willingness to work together • cooperation among disaster units • information infrastructure • organizational flexibility	• Interviews (Q7-Q16,Q18, Q19,Q20,Q24) • official documents • disaster laws and regulations • post-disaster critiques • professional researches
3. How could advanced information systems be used to improve the	• adoption of IT • changes in organizational	• Interviews (Q9-Q25) • official documents

Research Questions	Needed Information	Data Sources
performance of the disaster management system?	structure • ongoing research projects • socio-technical capacity of the system • deficiencies in current system • opportunities for future development	• professional researches • *Cumhuriyet* weekly newspaper reports • On-site observations previously conducted

3.5 SAMPLING DESIGN AND INTERVIEWS

3.5.1 Sampling Design for Interviews

Due to the characteristics of the research population, a representative stratified sampling design was the most appropriate for the selection of organizations for interviews. According to Kerlinger and Lee (2000, 179), stratified sampling is proper when dissimilar groups exist in the population. In this sampling method, the population is composed of different groups (strata). The sample is chosen from each group that represents the general characteristics of a population composed of different groups.

I used several criteria to establish a sample of organizations to conduct the interviews. Three main types of organizations are involved in the disaster response system: public, non-profit and private. These three different types vary by jurisdictional level: local, national, and provincial, and international.

Other criteria were also taken into account in designing the sample: legal responsibilities, size of organizations, closeness to disaster locations, and involvement in mitigation projects. Based on documents, professional reports, and a previous study, I identified a set of disaster organizations involved in response operations during the earthquakes and in efforts to change the organizational and informational infrastructure after the 1999 earthquakes. I then constructed a sample of decision makers from primary organizations for interviews. Therefore, the key decision makers, the unit of observations, are selected from each organization in the sample for interviews. The main criteria for the selection of the key decision makers are their hierarchic positions and specific responsibilities regarding disaster affairs, and their involvement in the disaster mitigation efforts.

3.5.2 Conducting the Interviews

I conducted field trips to all provinces, Kocaeli, Sakarya, Yalova, Duzce,[3] Bolu, Istanbul, Bursa, and to two districts, Golcuk and Avcilar, that were primarily affected by the Marmara and Duzce Earthquakes to interview the key actors in provincial and local organizations. I also conducted interviews with the public-central actors in Ankara, the capital city of Turkey. Field trips were carried out from June 1 to July 27, 2004.

I conducted 39 interviews with key actors in the disaster organizations during this period (see Appendix A for interview questions). During these trips, I also collected materials regarding the organizations' operations in disaster affairs, such as archival documents, brochures, professional notes, books of disaster laws and policies, progress reports, and disaster plans.

After identifying the primary organizations, I planned to interview 41 key actors in disaster organizations. I was not able to secure all of my planned interviews for several reasons. I interviewed some of the actors in different organizations with different positions. One had

[3] Duzce was a district administration during the Marmara earthquake and became province right after the earthquake.

resigned from his job,[4] another had retired.[5] I also had difficulties in contacting some of the interviewees as planned.[6] Fortunately, I was able to interview the 39 key decision makers from disaster agencies. Table 5 presents the information about the organizations in which I conducted interviews with responsible decision makers.

I contacted the most of the sample organizations by telephone. With the assistance of a professional advisor,[7] I was able to meet the responsible managers from most of the primary organizations. I contacted three of the organizations which I sought to interview via email: Sayisal Grafik, Japan International Cooperation Agency and TUBITAK Marmara Research Center. The selected interviewees preferred to answer the questions in detail via email. The head of the Technical and Operational Department from Turk Telecom was not able to meet with me and preferred not to answer the interview questions via email. However, he did email to me some important documents.

I conducted a total of 58 interviews with 39 key decision makers. Nineteen of the 39 interviewees had been involved in both the Duzce and the Marmara operations. I gathered information from the interviewees regarding the performance of the disaster agencies during the Duzce earthquake to compare the performance of Turkish disaster management in the two response systems.

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[4] I planned to interview with the Deputy Director of Turkish Red Crescent Society (Kizilay) during the earthquakes. He was also the former General Director of Disaster Affairs. During the time of conducting interviews, he had just resigned from his job in Kizilay. I interviewed him at his new job as the President of Organizational Development in the National Earthquake Council.

[5] The interviewee, the former Deputy Director of Disaster Affairs during the earthquakes, retired and was working as a consultant in Middle East Technical University, during the time of interview.

[6] The commander of Turkish Land forces Logistic Department first accepted to make the interview and then declined.

[7] I want to thank to the Undersecretary of Turkish Health Ministry, Dr. Ulvi Saran for his help in arranging meetings with interviewees.

Table 5 Organizational Sample and Distribution of Completed Interviews

Type of Organization	Name of Organization	Location	Position of Interviewees	Completed Interviews	
				Marmara	Duzce
Public-central	General Directorate of Civil Defense	Ankara	Department Head	1	1
	General Directorate of Land Registry and Cadastre	Ankara	Project Manager (MERLIS)	1	
	General Directorate of Disaster Affairs Earthquake Research Center	Ankara	Department Head	1	1
	BU Kandilli Observatory	Istanbul	Director	1	1
	General Directorates of Central Hydraulic Works	Ankara	Head of International Hydraulic Relations	1	
	Prime Ministry Crisis Management Center	Ankara	President	1	1
	General Directorate of Turkish Disaster Affairs	Ankara	Retired Deputy Director	1	1
	TUBITAK Marmara Research Center	Gebze-Kocaeli	Department Head	1	1
	General Command of Mapping	Ankara	Department Head	1	
	METU Disaster Management Center	Ankara	President	1	1
	GDDA Communication and Logistic Department	Ankara	Director	1	1
	Civil Defense Rescue Teams	Sakarya	Commander	1	1
	Bogazici University Earthquake Engineering	Istanbul	Department Head	1	1
Public Provincial	Bursa Province Government Crisis Management Center	Bursa	Deputy Governor	1	
	Bolu Province Government	Bolu	Deputy Governor	1	
	Crisis Management Center	Duzce	Director	1	
	Bolu Crisis Management Center	Bolu	Director	1	1
	Sakarya Province Government	Sakarya	GIS Expert	1	
	Sakarya Crisis Management Center	Sakarya	Director	1	1
	Istanbul Province Crisis Management Center	Istanbul	Deputy Director	1	1
				Marmara	Duzce

Type of Organization	Name of Organization	Location	Position of Interviewees	Completed Interviews	
Public Provincial	Kocaeli Province Government	Kocaeli	Deputy Governor	1	
	Yalova Crisis Management Center	Yalova	Director	1	
	Yalova Province Government	Yalova	Deputy Governor	1	
	Duzce Province Government	Duzce	Deputy Governor	1	1
	Kocaeli Urban Planning	Kocaeli	Director	1	
Public-district	Golcuk Crisis Management Center	Golcuk	Director	1	
	Avcilar Crisis Management Center	Avcilar	Director	1	
Public-municipality	Kocaeli Municipality	Kocaeli	Head of Fire Department	1	
	Bolu Municipality	Bolu	Director of Land Development	1	1
	Earthquake and Soil Directorate, Istanbul Greater Municipality	Istanbul	Director	1	
	Sakarya Municipality	Sakarya	Head of Fire Department	1	
	Istanbul Greater Municipality Emergency Coordination Center	Istanbul	Director	1	
	Bursa Municipality Emergency Coordination Center	Bursa	Head of Fire Department	1	
Nonprofit	AKUT	Istanbul	General Secretary	1	1
	KIZILAY	Ankara	Retired Deputy Director	1	1
	Turkish Radio Amateur Club	Istanbul	President	1	1
	KIZILAY Emergency Coordination Center	Ankara	GIS expert	1	
International	JICA	Ankara	Director	1	1
National Private	Sayisal Grafik	Istanbul	Product Manager	1	
Total				**39**	**19**

3.6 DATA ANALYSIS AND INTERPRETATION

Both qualitative and quantitative methods are used to analyze the data and present the findings of this study. Qualitative data from semi-structured interviews allowed me to investigate the factors that hinder or facilitate the performance of disaster organizations. I also applied the concept of N-K method to actual disaster circumstances to measure the frequencies and directions of information exchange among disaster agencies (Kauffman 1993; Comfort 1999). The analyses illustrate the patterns of communication and interactions, and the gaps between the informal and formal disaster system formation. Additionally, UCINET results (Borgatti, Everett, Freeman 2002) are used to identify the network structure in the response operations after the 1999 earthquakes, and to track the progress of adoption of information systems into the Turkish disaster management system since the earthquakes.

3.6.1 Descriptive Analysis

The semi-structured interviews and other secondary data sources are used for the descriptive analysis. One of the purposes of this analysis is to determine the initial conditions of the Turkish disaster management system during the 1999 response operations. Then, I describe the progress in the Turkish disaster management after the 1999 earthquakes.

The descriptive analysis is primarily focused on exploring the factors that facilitate or restrain the performance of disaster organizations. In this regard, existing informational capacity, information sharing ability, local sustainability, and organizational flexibility of the system were examined.

3.6.2 Statistical Analysis

3.6.2.1 Paired t-test

Data collected from interviews are used for a statistical analysis. The statistical analysis is used to determine if there is a significant difference between the Marmara and Duzce response operations in terms of disaster system performance.

As previously noted, 19 of 39 interviewees were involved in both response systems. I used a method based on paired samples for comparing the means of two populations since there is a natural pairing of the members of the two populations (Weiss 2005). Based on the data gathered from the respondents, a paired-t test was used to test to what extent the utilization of information and communication systems had an impact on the performance of the disaster system by allowing information exchange among disaster organizations.

3.6.2.2 Two Population Proportions Test

Data collected from the content analysis of *Cumhuriyet* following 21 days of the Marmara and Duzce earthquakes are used for "two population proportions test". Since there is a considerable difference between the number of transactions reported for the two response systems, comparing the proportions rather appears more appropriate methods. The transactions in the two different response systems were compared to see whether communication and coordination functions increased significantly. Therefore, this comparison will assist me to determine if there is a significant increase in search and rescue capacity of the Turkish disaster system from the Marmara to Duzce earthquakes as a result of increasing communication and coordination functions.

3.6.3 Network Analysis

Network analysis is used to discover social network structure among disaster agencies both in the 1999 disaster operations and in redesigning projects of the Turkish disaster system after 1999 to present. Data were gathered from primary sources such as the content analysis of *Cumhuriyet* for 21 days following the two earthquakes, data from *Cumhuriyet* news reports from May 1998 to May 2005, official websites of disaster agencies, archival data, semi-structured interviews, and professional reports are used for the network analysis.

Network analysis identifies the interactions among the actors (*e.g.* disaster organizations) rather than the attributes of the actors (Hanneman 2001). I used the UCINET software program for social network analysis (Borgatti, Everett, Freeman 2002). The social network analysis is based on five basic measurements of centrality and cliques' data (Hanneman 2001), that the UCINET software program (Borgatti, Everett, Freeman 2002) provides to analyze the whole disaster system network structure:

1. **Degree Centrality***:* Measures which organizations have the most ties to which other organizations.
2. **Closeness Centrality:** Measures the distance of an organization to all other organizations in the network by focusing on the shortest distance from each organization to all others.
3. **Betweenness Centrality:** Measures which organizations have more positional advantage to the extent that they fall on the shortest pathway between other pairs of organizations.
4. **Flow Betweenness Centrality***:* Measures not only the shortest pathways between the two pairs of organizations but also all other alternative pathways that an organization can use to reach the others.

5. **Cliques:** In addition to the centrality measures, I analyzed cliques' data for the network analysis. Cliques (sub-groups) statistics are important data for analyzing the whole disaster network structure. "A clique is a sub-set of a network in which the actors are more closely and intensely tied to one another than they are to other members of the network" (Hanneman 2001, 79). These statistics show the sub-network structures within the larger network.

I constructed matrices by using the data collected from the primary data sources. In the matrices, I used "binary nominal level of measurement". If an interaction exists between organizations, it is coded "1". If no interaction exists, it is coded "0". Then, I imported the matrix into the UCINET social network software program (Borgatti, Everett, Freeman 2002).

I performed two network analyses. First, I conducted a network analysis based on the data gathered from content analysis of *Cumhuriyet* for 21 days following the Marmara and Duzce earthquakes to identify the interactions among organizations. This analysis explored the patterns of communication and information exchange among disaster organizations during the disasters.

Second, I conducted a network analysis based on the data gathered from content analyses of weekly *Cumhuriyet* news reports from May 1998 to May 2005, official websites of disaster agencies, archival data, semi-structured interviews, and professional reports. This analysis provided information to measure the advancements in the informational and organizational capacity of the disaster system after the disasters. The analysis documented the communication and interaction patterns among the disaster organizations in implementing information infrastructure before and after earthquakes.

3.6.4 Quantitative Methods

The research utilized the concept of Kauffman's (1993) N-K system developed by Comfort (1999). Comfort (1999) applied Kauffman's (1993) N-K system to actual disaster environments to measure the content, frequency, and direction of interactions among disaster agencies during earthquake response operations. In an N-K system, the content, direction, frequency of information exchange and interactions among the components determine the process of progression. In this system, the interacting components have a choice to accept or reject the information. This requires both order and flexibility. The interacting parts of the system should have the capability to arrange and change their behaviors accordingly. The learning capacity of the components signifies the performance of the whole system to behave reciprocally.

In this study, I utilized this method to explore the types, directions, and frequencies of transactions and interactions among disaster organizations from different organizational and jurisdictional levels in the 1999 Marmara and Duzce response systems. In this analysis, measurements are:

N= Number of actors involved in disaster response systems

K= Number of interactions among disaster agencies

T= Number of transactions among disaster agencies

D= Duration of interactions

S= Sources of actors-public, nonprofit, private

Thus, I compared the results of this analysis with the findings from two social network analyses to identify whether the changes after 1999 earthquakes were implemented in accordance with actual needs. The analysis illustrates when, where and what are needed for effective, coordinated disaster operations.

3.7 SUMMARY

This chapter presented the research design and methods that are applied to the study. It defined research questions and objectives, unit of analysis and unit of observation, sampling design and identification of key decision makers, data collection, data analysis techniques and interpretations.

The chapter described the data sources and uses of the various data for three major analyses: descriptive analysis, network analysis and Kauffman's N-K system analysis. The main purpose of descriptive analysis is to identify the factors that hinder or facilitate the performance of the Turkish disaster system. The chapter defined the network analysis that is performed by using UCINET software program (Borgatti, Everett, Freeman 2002) to measure the patterns of interactions among disaster agencies in the 1999 earthquake response operations and in the projects initiated after the earthquakes. Finally, the chapter defined the N-K system that is utilized to investigate the characteristics of transactions and interactions among disaster agencies to determine the gaps between informal and formal disaster management structure.

4.0 TURKISH DISASTER MANAGEMENT POLICIES AND STRUCTURE

4.1 INTRODUCTION

The characteristics of disaster policies and structure identify a nation's perception of the problem and determine the ultimate capability of the system to anticipate and overcome the consequences of the problem. Coordination of organizations before and after earthquakes, and clearly determining the authority and responsibilities of disaster organizations are very important factors that facilitate or inhibit the performance of a disaster management system. In this respect, disaster policies become very important tools that expand the capacity of a disaster management system to reach a point in which the system performs at its maximum. A nation should establish a disaster policy and structure that captures the nonlinear dynamic characteristics of the problem and should have the flexibility to allow individual organizations in the disaster system to act upon changing environments.

This chapter analyzes the Turkish disaster policies and organizational structure. The chapter also reviews the changes in disaster policies and disaster management structure after the 1999 earthquakes.

4.2 TURKISH DISASTER POLICIES

In the disaster literature, three historical periods are considered milestones in Turkish disaster policy administration (TBMM 1997; TBMM 1999; DPT 2000; Akdag 2002): prior to 1944, 1944 to 1958, and 1958 to 1999. In addition to these periods, the year 1999 is a starting point for important organizational, technical, and regulational changes. The historical root of the Turkish disaster policies illuminates the successes and failures of present disaster policies and organizational structure.

Today, there are several important rules that regulate the Turkish disaster policies. Disaster Law (No. 7269), Civil Defense Law (No. 7126), and Disaster Regulation 12777 are the primary ones. In addition to these laws and regulations, many consider the development laws as important as disaster laws (Keles 2002; Balamir 2001). Although the development laws are not considered to be disaster laws, they, indirectly but significantly, affect the success of disaster policies. Therefore, the first part of the chapter primarily examines the Disaster Law 7269 and the Development Law 3194 in detail as they are two of the most important regulations regarding disaster policies.

4.2.1 The Disaster Law of 7269

The main law that regulates the Turkish Disaster Management is Disaster Law (No. 7269), which was passed by Turkish Grand National Assembly in 1959 (Afet Isleri Genel Mudurlugu 1998). This law covers all regulations regarding disaster affairs and mainly identifies the tasks of disaster organizations before and after disasters. It remains the primary law governing disaster affairs. Under the light of new circumstances, the law has been partly changed and various amendments (1968/1051, 1981/2479, 1985/3177, 1995/4133) were enacted into the law (TBMM 1997; Akdag 2002).

The law did not specify detailed emergency planning and organizational schema until 1988. In that year Disaster Regulation of 1277 was created to clarify emergency planning issues. The regulation provided an outline for the national emergency plan and required institutions, ministries, province, and district governments to create their own specific emergency plans. Disaster Law 7269 awards extraordinary authorities to provincial and district governments to undertake necessary actions and to use public, private and even military properties for response operations.

The Disaster Law is considered highly advanced and comprehensive for the era in which it was created, however, it has not adapted over time to changing conditions. Although the Disaster Law clarifies the tasks to be carried out before and after disasters, it focuses fundamentally on the response and recovery stages of disasters (National Earthquake Council 2002). The major goal of Disaster Law 7269 is to recover and rehabilitate after a disaster happens, rather than to reduce seismic risk and create a disaster resilient community (National Earthquake Council Report 2002).

It has been a challenge for Turkish public administration to revise the traditional linear disaster policies in order to capture the complexities of risk. The organizational tradition of Turkish public administration has characterized the Turkish disaster policies and management structure that can be traced back to the Ottoman Era.

4.2.2 The Evolution of the Turkish Disaster System

The first written document regarding Turkish disaster affairs was regarding the earthquake that occurred in 1509. Following that disaster which killed 13 thousand people in Istanbul, II Beyazit, the emperor of the Ottoman Empire gave orders to assist the earthquake victims. The Ottoman administration gave 20 gold pieces to each family, and assigned construction experts to rebuild their homes. Similar post-disaster efforts were made during the Ottoman era.

In 1848, the Ottoman administration established Ebniyye Nizannamesi, a regulation, to control construction facilities in Istanbul. In 1877, this regulation was expanded to encompass all municipalities within the Ottoman Empire. The law of Ebniyye was extended in 1882 to regulate infrastructure and roads. Although these regulations were established to manage urbanization, they can be considered the first attempt to reduce the vulnerabilities of Turkish communities to disaster.

After the foundation of the modern Republic of Turkey, the approach to disaster management did not differ considerably from that of the Ottoman Empire. In 1933, the Act of 2290, The Municipality Building and Roads Law, significantly altered the Ebniyye Nizannamesi. This law decided all regulations regarding land development, infrastructure, roads, buildings and construction activities. Subsequent to The Erzincan earthquake on December 26, 1939, the deadliest earthquake in Turkish history, Turkish public administration established some temporary regulations and policies to assist the victims of the earthquakes. From 1939 to 1944, five destructive earthquakes struck Turkey: Erzincan, Niksar-Erbaa, Adapazari-Hendek, Tosya-Ladik, and Bolu-Gerede. These earthquakes killed more than 43 thousand people, injured over 75 thousand and damaged in excess of 200 thousand buildings (Akdag 2002). These incidents showed that it is not possible to diminish the negative consequences of a disaster by simply rebuilding homes after an earthquake. In 1944, the Turkish disaster administration took the first steps toward mitigation.

In 1944, Turkey passed The Law for Measures to be Taken Before and After Earthquakes. This law (No. 4623) was the first regulation that Turkish public administration established for mitigation purposes. It required Turkish public administration to identify seismic risk prone areas, create special rules for construction facilities in these areas, develop aid and rescue plans before earthquakes, and prevent settlement before geological examination of the land (Akdag 2002; TBMM 1997). In 1945, the Public Works Ministry created the first seismic risk map of Turkey and established the first regulation of mandatory construction codes for disaster prone areas.

The primary laws, regulations and institutional establishments were established during 1958-1999, including Disaster Law 7269, the new Development Law 3194, and Civil Defense Law 7126. During this period, the key institutions, Public Works and Settlement Ministry, General Directorate of Disaster Affairs, and General Directorate of Civil Defense were founded.

The primary legal and organizational progress in the Turkish Disaster Management System from 1958 to 1999 shaped the fundamental patterns of the Turkish disaster system. Although these developments indicate an advanced understanding of disaster affairs from earlier periods, the system has not shown a significant capacity to build disaster resilient communities. The focus on response and recovery phases, policies and organizational structure based on traditional linear assumptions, and the lack of sufficient organizational and technical capacity constrained the ability of the system to cope with the problems of destructive earthquakes during that period. Another important factor affecting the adequacy of the disaster system was that the decision makers did not use land development policy as a tool to establish disaster resilient communities in risk prone areas (Balamir 2001; Keles 2002).

4.2.3 The Development Laws and Disaster Affairs

One of the main critic issues of Turkish disaster policies is that "disaster policies and development policies are not well connected" (Keles 2002; National Earthquake Council Report 2002). From Ebniyye Nizannamesi in 1848 to the new Development Laws 3194 in 1988, the changes in development regulations did not consider the seismic risk, especially in metropolitan areas, as an important aspect of development policies.

According to Municipality Law 1580 and the Municipality Building and Roads Law 2290, established in 1930 and 1933 respectively, municipalities have the authority and the responsibility for land development and construction activities in cities. However, in the 1950s, domestic migration toward bigger cities, urbanization, and increasing industrial facilities in metropolitan areas created huge problems and construction activities became very difficult to control. Therefore, the Turkish Grand National Assembly passed a development law (No. 6785) in 1956 to regulate development affairs in cities. However, Development Law 6785 could not solve the problems of land development.

Populist policies to win elections and the willingness of public officials to excuse illegal construction activities made this problem nearly unsolvable. In 1988, the Turkey Grand National Assembly passed a new Development Law, 3194, to replace the old 6785 in order to deal with the increasing level of urbanization problems. Today, Development Law 3194 is the major law that regulates the matters of land development, construction, and construction monitoring.

As with the previous law, the final Development Law proved insufficient to address the problems of illegal construction activities in cities. According to current Turkish officials, today, approximately one half of the buildings in Istanbul are illegally constructed.[8]

> "…there are approximately 1.2-1.3 million buildings, inside the metropolitan city of Istanbul. But only 600-700 thousand of them are legally constructed. We should have more comprehensive land development laws and these laws should be strictly implemented."

Keles (2002) claims that Development Law 3194 is inadequate and outdated. Municipalities with populations over 10 thousand and provincial governments are responsible for the preparation of development plans. However, they are not required to incorporate seismic data into the plans. Further, many municipalities lack the technical and financial capacity to design and implement development plans. Therefore, from planning phases to control phases, construction activities pose a huge dilemma for the disaster system. Keles (2002) asserts that construction control is almost non-existent in Turkey.

In conclusion, several issues must be considered in Turkish development and disaster policies (National Earthquake Council Report 2002; Istanbul Emergency Master Plan 2003). First, populist policies continue to extend illegal settlements into metropolitan areas. Second, the Development Law and the Disaster Law are not considered to be two sides of a single coin. The Development Law should consider seismic risk as a basis for land-use and settlement in cities. To achieve a successful disaster policy, "the practice of land-use planning and zoning, transportation and infrastructure planning, procedures for density assignment, planning the open spaces, participation processes, strengthening and devising new methods monitoring building-use control, etc., all of these are distinct aspects of disaster concerns that naturally need to be

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[8] Interview with Emergency Coordination Center, Istanbul Metropolitan Municipality, June 22, 2004

covered in the Development Law" (Balamir 2001, 210). A third criticism is that there is an uncertainty about the authority and responsibility of organizations over land development issues. Many organizations have partial responsibilities for land development and physical planning making it difficult to track and enforce the illegal construction activities in metropolitan cities.

4.3 TURKISH DISASTER MANAGEMENT STRUCTURE

Local and central Turkish disaster management is structured according to Disaster Law 7269. According to this law, the General Directorate of Disaster Affairs under the Ministry of Public Works and Settlement is responsible for preparedness, response, and recovery operations and coordination of these activities. In addition, several ministries have responsibilities and authority at different stages of the disaster management process (Keles 2002), creating a significant confusion for coordinating the disaster activities. To avoid this problem at the provincial level, the law allocates power to provincial governors to administer provincial branches of ministries.

The confusion of power and responsibility is a significant problem at the central level of disaster administration as well. At the central level, along with the General Directorate of Disaster Affairs, the General Directorate of Civil Defense was established under the Interior Ministry to carry out the tasks that Civil Defense Law 7126 defines. The GDCD also carries out the tasks mandated by Disaster Law 7269, and Disaster Regulation 12777 (Corbaciaglu and Kapucu 2005). Other organizations such as the Prime Ministry's Emergency Coordination Council and the Disasters Center Coordination Council have responsibilities and authority for coordination of disaster operations after a disaster happens.

In order to expose the coordination problems of the Turkish disaster system, we should examine the formal Turkish disaster management structure. The Turkish disaster management structure is organized at central and local levels. At the local level, the provincial rescue and aid committee is responsible for disaster operations. If a disaster exceeds the capacity of disaster agencies at the local level, the responsibility and authority go from the local level to the central level disaster agencies. The Central Disaster Coordinating Committee is the main body at the central level. If a disaster threatens the life and security of the nation, the prime minister declares a crisis management situation and the Prime Ministry's Crisis Management Center takes charge.

4.3.1 Turkish Disaster Management at Local Level

Local level organizations are the first response actors in the Turkish disaster system. Disaster Law 7269 and the Regulation 12777 require district and provincial disaster organizations to prepare emergency plans before a disaster, and respond to the disaster accordingly. If a disaster is relatively small, public-district disaster organizations respond under the district managers, Kaymakam. If the resources and agencies of districts are insufficient to handle the disaster, provincial public disaster organizations take over the authority under the command of the provincial governor. Figure 3 shows the local disaster management structure.

This structure appears ideal since it provides the responsibilities and power to local organizations for immediate response to disasters. However, it is not practically functional because the local disaster organizations do not posses sufficient technical and organizational capacity to cope with a major disaster. In many cases, such as the Marmara and Duzce earthquakes, the local communities are overwhelmed by the disasters and do not have the ability to perform their responsibilities.

Provincial Response Committee

Chairman : Governor of the Province

Mayor
Commander of Gendarmerie

Directors of:

Police
Civil Defense
National Education
Public Works and Settlements
Health
Agricultural and Rural Affairs
Energy and Natural Resources
Local Representative of the TRCS
Local Military Commander

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Emergency Aid Services Groups

Communication Services
Preliminary Damage Assessment and Temporary Shelter Services
Transportation Services
Public Security Services
Approbation Renting Confiscation & Distribution Services
Rescue and Debris Removal Services
First Aid & Medical Services
Agricultural Services
Lifeline Services

Sources: JICA (2004), Ergunay (1999).

Figure 3 Provincial Rescue and Aid Committee

4.3.2 Turkish Disaster Management Central Level

The Central Disaster Coordinating Committee is the main body in the Turkish disaster management structure at the central level. The committee is responsible for responding to a disaster if provincial rescue and aid groups are not able to overcome the problems of the disaster. The schema of this committee is shown at Figure 4.

There are two main organizations at the central level that are responsible for coordinating disaster affairs: the General Directorate of Disaster Affairs and the recently founded General Directorate of Turkey Emergency Management (GDTEM). However, when a disaster occurs, two other organizations at the central level join these two organizations in coordinating disaster operations: The General Directorate of Civil Defense (GDCD) and the Prime Ministry Crisis Management Center (PMCMC).

GDCD operates under the Interior Ministry and is the major organization responsible for coordinating rescue operations. In addition to GDCD, PMCMC is another coordinating establishment after a disaster threatens the wellbeing of Turkish people. According to the regulation of 8716 (1996), if the prime minister declares an emergency situation, the PMCMC steps in command and becomes the main body of the disaster management system. Figure 5 shows the structure of the Prime Ministry's Crisis Management Center.

The Cabinet Ministries

Chairman: Undersecretary of the MPWS

Undersecretaries of the ministries:

National Defense
Foreign Affairs
Interior
Finance
National Education
Health
Transportation,
Agriculture and Rural affairs
Industry and Trade
Forestry
Environment

And

President of the Red Crescent Society
Representative of Turkish General Staff (Army)

Secretariat: GDDA

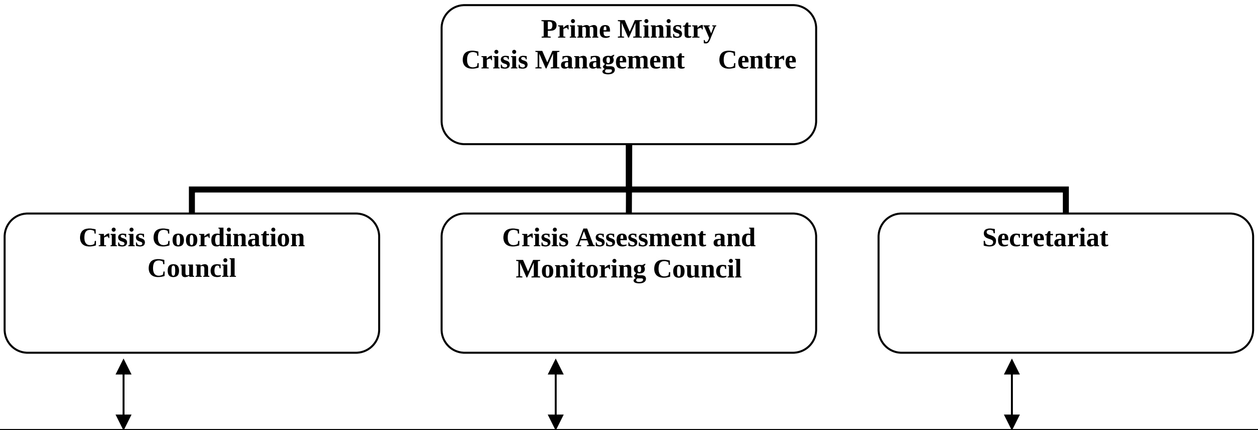
Sub-Committee

Deputy Undersecretaries and General Directorates of above Ministers

Sources: JICA (2004), Ergunay (1999)

Figure 4 Central Disaster Coordination Committee

Hence, after the declaration of an emergency situation, four units at the same hierarchical level become the coordination agency. The General Directorate of Disaster Affairs (GDDA), the Prime Ministry Crisis Management Center (PMCMC), the General Directorate of Civil Defense (GDCD) and the GDTEM are the major organizations at the same organizational level that are responsible for similar tasks in the system. The similar organizational and legal bases of these organizations create a conflict of authority.

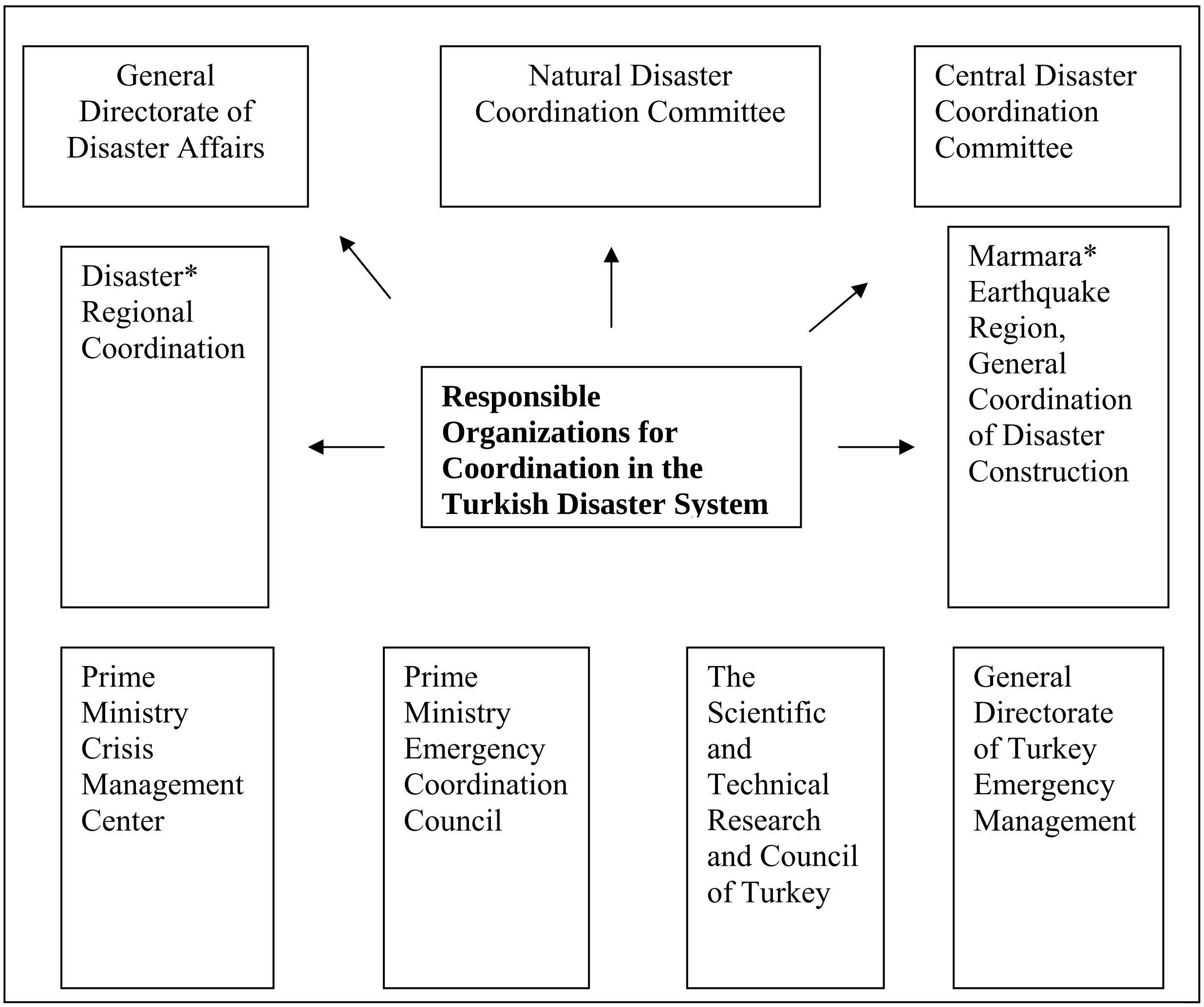


Chairman: Prime Minister or Related Central Minister	**Chairman:** Undersecretary of Prime Minister	**Chairman:** Deputy Undersecretary of Prime Minister
Chief of the General Staff (or Representative Central Minister on Economy Minister of Justice Minister of National Defense Minister of Interior Minister of Foreign Affairs Minister of Finance Minister of National Education Minister of Public Works and Settlements Minister of Health Minister of Transportation Minister of Agriculture and Rural Affairs Minister of Labor and Social Security Minister of Industry and Trade Minister of Energy and Natural Resources Minister of Forestry Minister of Environment Secretary General of National Defense Council Other Ministers as Required	Representative of the General Staff Undersecretary of Justice Undersecretary of National Defense Undersecretary of Interior Undersecretary of Foreign Affairs Undersecretary of Finance Undersecretary of National Education Undersecretary of Public Works and Settlements Undersecretary of Health Undersecretary of Transportation Undersecretary of Agriculture and Rural Affairs Undersecretary of Labor and Social Security Undersecretary of Industry and Trade Undersecretary of Energy and Natural Resources Undersecretary of Forestry Undersecretary of Environment Representative of the General Secretariat of National Defense Council President of Council for Higher Education Undersecretary of the National Intelligence Organization Undersecretary of SPO Undersecretary of Treasury Undersecretary of Foreign Trade President of the Central Bank President of the Turkish Atomic Energy Authority President of the TRCS Representatives of Other Ministries and Institutions as Required	General Directors and Experts from Ministries and Institutions

Sources: JICA (2004), Ergunay (1999)

Figure 5 Prime Minister Crisis Management Center

In addition to these organizations, there are others that are fully or partially responsible for coordination of disaster operations during a major disaster. As Akdag (2002) ironically observes, there are almost more coordination agencies than response agencies in the system (Figure 6).



Source: Adapted from Akdag(2002)
*Organizations for only the Marmara and Duzce earthquakes

Figure 6 Organizations Responsible for Coordination in the Turkish Disaster System

4.4 DEVELOPMENTS AFTER THE 1999 EARTHQUAKES

After the 1999 Marmara and Duzce earthquakes, several significant legal and institutional reforms were introduced into the Turkish disaster system. The General Directorate of Turkey Emergency Management and the National Earthquake Council were added to the system to improve coordination among disaster organizations before and after disasters. The General Directorate of Civil Defense established 11 professional rescue groups in different parts of the country to increase the response capacity of the system.

Some important legal changes were also made after the earthquakes. A mandatory earthquake insurance system and cabinet decisions for a new Building Construction Control System were the most important legal initiatives for reducing the hazardous effects of earthquakes.

4.4.1 General Directorate of Turkey Emergency Management

After the 1999 earthquakes, Turkish public administration attempted to address the problems of intergovernmental coordination. In order to coordinate efforts before and after a disaster, a new organization was established. Based on the Cabinet decision number 583/1999 and 600/2000, and with financial support from the World Bank, the General Directorate of Turkey Emergency Management (GDTEM) was founded under the Prime Ministry. In 1999, the institution was established as a directorate and later in 2000 it was promoted to the level of general directorate. The GDTEM became responsible for coordinating public disaster agencies for natural or man-made disasters that threaten the security of the nation. The primary tasks of the GDTEM are (Corbacioglu and Kapucu 2005):

- Coordinating the operations of public organizations,
- Enabling public organizations to establish emergency management centers,
- Establishing a disaster database, creating short and long term plans and assessing the attempts of disaster organizations to diminish the risk of emergency,
- Encouraging volunteer activities,

The GDTEM was established to solve coordination problems among public disaster organizations in the disaster system. However, the legal basis of the GDTEM does not allow the organization to effectively perform this main goal. In the hierarchical Turkish public administration, the GDTEM lacks authority over the primary disaster organizations. The current legal and institutional formation of the GDTEM made the coordination issue more complex in the Turkish disaster system.

Some argue that a new organization was not necessary to perform these tasks.[9] They claim that one of the organizations among the General Directorate of Disaster Affairs (GDDA), Prime Ministry Crisis Management Center (PMCMC), General Directorate of Civil Defense (GDCD) could be reorganized to perform these duties. On the other hand, some argue that a new coordinating agency was required in the organizational structure of the disaster system.[10] However, they assert the GDTEM should be formed at a higher level, such as undersecretary of a ministry, to eliminate any power conflict among the agencies.

According to one expert, the reason for this conflict was that the GDTEM was established in a hurry without much consideration or preparedness.[11] The World Bank promised millions of dollars in financial assistance after the 1999 earthquakes. The condition for obtaining

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[9] Interview with Earthquake Research Center, GDDA, June 10, 2004
[10] Interview with The Red Crescent Society, June 9, 2004
[11] Interview with METU Disaster Management Center, June 8, 2004

this assistance was the establishment of a new coordination agency in the Turkish disaster system. The GDTEM was established before the last day of deadline to obtain this financial assistance. In June 2004, the GDTEM lacked the personnel, organizational, and technical resources to perform any of its duties.[12]

4.4.2 National Earthquake Council

The Prime Ministry's Office established a scientific, independent National Earthquake Council in March 2000. The National Earthquake Council was created to evaluate and unite discussions among experts about future earthquakes. According to the decision 2000/9, the council consists of 20 experts selected from universities, public disaster organizations, and professional institutions. Turkey Scientific and Technical Research and the Council of Turkey became the responsible organizations for the foundation of the council. TUBITAK also performs as the secretary of the council. The major missions of this council are (Balamir 2001):

- To evaluate the assertions and predictions for future seismic risk, and to share the findings with the authorities and public,
- To identify priorities for research activities for reducing seismic risk,
- To provide consultation for public disaster agencies,
- To prepare strategic disaster policies,

The council met on June 16, 2000. In 2002, the council prepared its first report, National Strategic Report for Reducing the Harmful Effects of Earthquakes. The council offered the report

[12] Interview with General Directorate of Turkey Emergency Management, June 7, 2004

to all public institutions, including the Turkish Grand National Assembly. The report identified the legal, institutional, land development, informational, and educational aspects of disaster administration, and recommended the actions that are to be taken for mitigation. Unfortunately, because of changes in the administration of TUBITAK, the council has not been very effective in gathering the responsible organizations in order to discuss and implement the policies that the strategic report recommended (JICA 2004).

4.4.3 Increasing Search and Rescue Capacity of the System

After the Marmara and Duzce disasters, the General Directorate of Civil Defense increased the number and competence of professional search and rescue groups to improve the system's response capacity. By Cabinet Decisions 586/1999 and 596/2000, the General Directorate of Civil Defense established well-trained rescue groups equipped with advanced technical vehicles in 11 cities: Adana, Afyon, Bursa, Diyarbakir, Erzurum, Istanbul, Izmir, Sakarya, Samsun and Van. GDCD assigned these rescue teams to some groups of provinces and determined the primary responsibilities of teams based on the location of a disaster. Each rescue team includes 100-120 personnel, and operates as a regional rescue team.

In addition, the Turkish Armed Forces have founded natural disaster rescue troops consisting of members from the Army, Navy, Air Forces, and Gendarmerie (Corbacioglu and Kapucu 2005). Further, many volunteer search and rescue groups have been established in provinces in the Marmara region. All of these developments significantly increased the response capacity of the disaster system. Many agree that the search and rescue function of the Turkish disaster system is the most developed element of the system since the 1999 earthquakes.[13]

4.4.4 Mandatory Earthquake Insurance System

According to Disaster Law 7269, the central government was responsible for rebuilding the damaged properties of citizens after a disaster occurs. Experiences have proved this policy to be an obstacle in implementing earthquake resistant building codes. The residents in the risk-prone areas do not comply with earthquake resistant building codes since the state is the free insurer of the damaged properties. This policy creates a huge financial burden for the state. After the 1999 earthquakes, public managers decided to alter this policy and share the financial burden with citizens and encourage citizen compliance with regulations.

A mandatory earthquake insurance system was established on December 27, 1999 by Cabinet Decision 587. After this decision, the state was no longer the free insurer of the damaged buildings following a disaster. Earthquake insurance was required for buildings constructed inside the borders of municipalities. A Natural Disaster Insurance Agency was founded to collect insurance money and administer the system. The insurance system covers 10 million, 71.4% of the existing properties (Gulkan 2001). Although this regulation was an important step for disaster mitigation, the implementation of this system has not been very effective.[14] The residents in

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[13]Interview with General Directorate of Civil Defense, June 8, 2004
Interview with Istanbul Province Government, June 21, 2004
Interview with Sakarya Civil Defense Rescue Group, June 15, 2004
Interview with Avcilar Crisis Management Center, June 22, 2004
[14] Interview with Bogazici University Earthquake Engineering, June 24, 2004

earthquake risk-prone areas still ignore mandatory insurance and are very reluctant to pay for it.[15]

4.4.5 Building Construction Inspection

The most important requirement for reducing seismic risk is to have a building stock that is rigorously constructed according to earthquake resistant codes. The inadequate policies in implementing building codes and controlling building construction have been the biggest problem of the Turkish disaster management system. The municipalities that have responsibilities for development plans and construction activities have proven reluctant to enforce the implementation of earthquake resistant building codes. To solve this problem, an important policy change was made by the Cabinet Decision 595 in April, 2000. According to this Cabinet Decision, the municipalities still had the authority for land development and construction permission. However, excluding public constructions, the new policy gave the responsibilities of monitoring constructing activities to certified private construction monitoring companies. These companies had the power to monitor construction activities from project phases to the end of construction. For ten years, they were legally responsible for the buildings that they inspected.

The rule initially applied to the 27 provinces including the provinces that were affected by the Marmara Earthquake. Although experts praised this new policy, it did not remain in effect very long.[16] A political party requested the Supreme Court to abandon this policy, and consequently the Supreme Court abolished the Cabinet Decision 595/2000 in 2001. In June 29

[15] Interview with Emergency Coordination Center, Istanbul Greater Municipality, June 22, 2004
[16] Interview with METU Disaster Management Center, June 8, 2004

2001, the Turkey Grand National Assembly passed a new Construction Monitoring Law 4708. The new law significantly altered many aspects of the Cabinet Decision 595. According to many professionals, the new law made the system more centralized and inadequate in implementing earthquake resistant building codes than it was before the 1999 Earthquakes (Gulkan 2001).

The changes in the disaster policies and institutional structure after the 1999 earthquakes, to some degree, have improved the capacity of the Turkish system. In particular, new civil defense rescue teams and numerous volunteer rescue groups in disaster stricken cities significantly increased the response capacity of the system. However, the modifications in disaster policies are not sufficient to alter the linear, centralized, and bureaucratic characteristics of the Turkish disaster management system.

4.5 SUMMARY

This chapter reviewed the evolution of Turkish disaster polices and management structure. Disasters, especially earthquakes, have created destructive consequences in every aspect of community life in Turkey. For centuries, a moderate earthquake has occurred almost every year. Turkish public administration has implemented many policies and institutions to address the problems of earthquakes since the Ottoman Empire. During the early periods prior to 1944, these policies focused on recovery and relief efforts after a disaster hit. After 1944, the Turkish public administration began to understand that the problems of seismic risk require a different approach in order to decrease the negative impact of earthquakes. During the period of 1958-1999, Turkish public administration established the legal bases and institutional structure of the Turkish disaster system. The establishment of new policies and organizational structure was distinguished from earlier periods and was considered an advanced step toward more appropriate disaster management design. Although the improvement in disaster policies was significant, the policies were primarily focused on the later stage of disaster management. The disaster administration acted as a healer rather than a protector. The bureaucratic and hierarchical Turkish public administration formed by linear policies constrained the ability of disaster agencies to address the problems of complex, dynamic risk. The 1999 earthquakes proved that policies primarily focused on the later stages of disaster mitigation, and an inflexible, bureaucratic management structure is destined to fail in situations of complex, dynamic, and uncertain risk.

The final sections of the chapter analyzed the attempts of the Turkish public administration to reorganize and restructure disaster policies and organizational formation to minimize seismic risk. In order to diminish the problems of coordination among the disaster organizations, the General Directorate of Turkey Emergency Management and the National Earthquake Council were established. The administration significantly increased the response capacity of the disaster system by founding rescue teams throughout the country. In addition to these organizational changes, some important policies were implemented. A mandatory disaster insurance program and the policies to increase enforcement for earthquake resistant building codes are important improvements. However, the review showed that these new institutional and legal changes have not yet effectively increased the capacity of the Turkish disaster system.

There are other attempts that the disaster organizations initiated to increase the technical and organizational capacity of the system. The next chapters will analyze these initiations to measure to what extent the disaster system has been improved.

5.0 THE INITIAL CONDITIONS OF INFORMATION INFRASTRUCTURE DURING THE 1999 EARTHQUAKES

5.1 INTRODUCTION

This chapter explores the initial conditions of the information infrastructure during the 1999 earthquakes. The questions of the study addressed in this chapter are:

How effectively did the existing information infrastructure of the Turkish Disaster Management System support the organizational response operations in the 1999 Marmara and Duzce Earthquakes?

a. What were the initial conditions of the information infrastructure before the earthquakes?

b. To what extent did the existing information systems provide a knowledge base to support coordinated actions among emergency organizations from different jurisdictions?

c. How did the existing information and communication technologies affect the interaction and exchange of information among emergency organizations during the disasters?

In order to address these questions, I analyzed the data collected from primary actors that were involved in response operations and participated in the projects initiated after the 1999

Earthquakes. In the first part of this chapter, I provide a descriptive analysis of sample organizations and the type of services that they perform. Then, I examine the initial conditions of the information infrastructure during the 1999 earthquakes. In this section, I compare the performance of the disaster system in both earthquakes to illustrate whether the utilization of information and communication means had a significant impact on the performance of the Turkish disaster system.

5.2 DESCRIPTIVE ANALYSIS OF THE SAMPLE ACTORS

5.2.1 Jurisdictions of Respondent Organizations

This section analyzes the jurisdictional and demographic characteristics of respondent organizations in the sample. Table 6 represents a list of organizations that participated in semi-structured interviews. Members from a total number of 39 organizations were interviewed. Thirty-nine interviewees responded to questions related to the Marmara response system, whereas nineteen of 39 respondents also answered questions regarding the Duzce response system.

As indicated in Table 6, most of the organizations in the sample are public-central organizations. Approximately 33% of organizations in the sample involved in the Marmara response operations are public-central organizations while 68.4% of 19 respondent organizations are public-central organizations that were involved in the Duzce response operations. Public provincial (30.8%) and public-municipality (10.3%) organizations are also important components of the sample for the Marmara response system. There are 2 district organizations that were involved in the Marmara response system, but not in the Duzce response system.[17]

Table 6 Summary of Semi-Structured Interview Respondents and Organizations

Type of Organizations	Semi-Structured Interview Respondents			
	Marmara Response System		Duzce Response System	
	N	%	N	%
Public-central	13	33.3	10	68.4
Public Provincial	12	30.8	4	21.1
Public-district	2	5.1	0	0.0
Public-municipality	6	15.4	1	5.3
Nonprofit	4	10.3	3	15.8
Private	1	2.6	0	0.0
International	1	2.6	1	5.3
Total	39	100	19	115.8

N= Number of Respondents; %= Percentage of Respondents
Source: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Interviewing respondents who were involved in both response systems allowed me to compare their perceptions of the performance of the Turkish disaster system in the two earthquakes. Different organizations from different jurisdictional levels provided evidence to evaluate the initial conditions of information infrastructure for two response systems. Comparing two different sets of data shows how information search, acquisition and exchange ability of the system affected the performance of Turkish disaster system.

[17] Duzce city was a district during the Marmara earthquake. Right after the Marmara earthquake, The Turkey Grand National Assembly issued a law that made Duzce a province. So, the respondent organizations from Duzce were coded provincial organizations instead of as district organizations.

5.2.2 Demographic Characteristic of Respondent Organizations

Demographic characteristics of the respondents show the validity of data collected from experienced managers in Turkish disaster management. The data in Table 7 represent the demographic characteristics of respondents and their organizations.

Table 7 Demographic Characteristics of Interviewee Organizations

Years of Experiences in Emergency Management Service	***N***	***%***	***Total Response***
1 year or less	0	0	
2-4 years	4	10.5	
5-7 years	8	21.1	
8-10 years	3	7.9	
More than 10 years	23	60.5	
Other (n/a)	1	-	
		100	**38**
Staff Size			
1-5	5	15.2	
6-15	7	21.2	
16-25	4	12.1	
26-50	3	9.1	
Over 50	14	42.4	
Other (n/a)	6	-	
		100	**33**
Budget			
0-25,000.00 YTL	0	0	
25,000.01-75,000.00 YTL	0	0	
75,000.01-150,000.00 YTL	4	19	
150,000.01- 500, 000.00 YTL	4	19	
More than 500, 000.00 YTL	13	61.9	
Other (n/a)	18	-	
		100	**21**
Education			
High school	0	0	
Bachelor’s Degree	26	68.4	
Master’s	5	13.2	
PhD	7	18.4	
Other (n/a)	1	-	
		100	**38**

	N	%	*Total Response*
Age			
20-30	2	5.4	
31-40	14	37.8	
41-50	17	45.9	
51-60	3	8.1	
61 and Over	1	2.7	
Other (n/a)	2	-	
		100	**37**
Gender			
Male	35	89.7	
Female	4	10.3	
		100	**39**

N= Number of Respondents; %= Percentage of Respondents
Source: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

According to the data above, most of the respondents have worked in the emergency field more than 10 years (23 of 38, or 60.5%). In terms of staff size, more than 40% of the organizations (14, or 42.4%) have in excess of 50 workers that carry out tasks for emergency purposes. Most representatives of organizations did not want to answer the question about their budget. Thirteen of the 18 interviewees (61.9%) who answered this question said that their organizations have a budget of more than 500,000.00 new Turkish Liras.

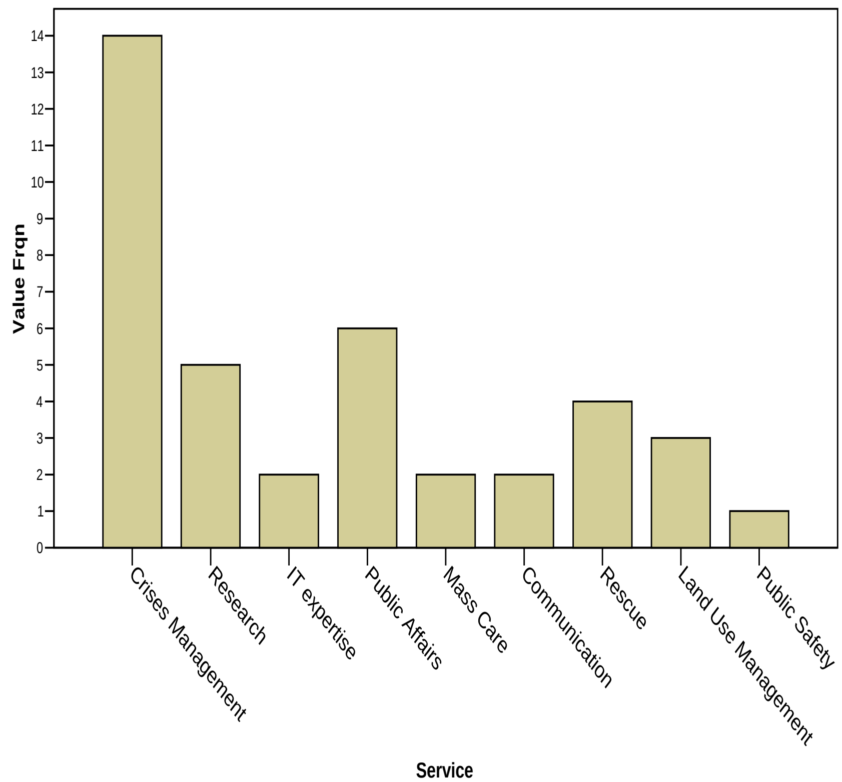
Most of the interviewees were middle-aged males with bachelor's degrees. All respondents have at least a bachelor's degree, whereas 5 (13.2%) have a master's degree and 7 (18.4%) have Ph.D. degrees. Out of 39 interviewees, 35 of them (89.7%) are males. Seventeen of 37 respondents (45.9%) are between 41 and 50 years old. More than 80% of respondents are between 30 and 50 years old. These findings combined with the result of the years of experience in service show that the respondents are quite experienced in emergency management.

5.2.3 Type of Services of Respondent Organizations

The respondents work in different organizations performing various tasks related to emergency management. Figure 7 depicts the type of services that interviewees' organizations offer. All of the organizations have responsibilities for emergency management to different degrees. Fourteen of 39 respondent organizations (35.9%) are primarily responsible for carrying out tasks in crisis management. These organizations perform tasks that cover all phases of disaster management.

There are four organizations (10.2%) that provide services in the field of information technology expertise and communication. These organizations are involved in various projects to increase the information and communication capacities of the disaster system. Five respondents, or 12.8%, do research for emergency purposes. These organizations are public-central organizations that include universities as well. Four, or 10.3%, are rescue organizations, and 2 of the respondent organizations (5.1%) including the only nonprofit organizations in the formal Turkish disaster system, the Turkish Red Crescent Society, are responsible for mass care. Since this study assumes that land development policies are essential for disaster mitigation, three respondents with authority over land development strategies are included in the sample. In addition to these services, six respondents, or 15.4%, provide various public services, and one organization (2.6%) is responsible for public security.

"What is the primary function of your organizations?"



Service	N	%
Crisis Management	14	35.9
Research	5	12.8
IT expertise	2	5.1
Public Affairs	6	15.4
Mass Care	2	5.1
Communication	2	5.1
Rescue	4	10.3
Land Use Development and Management	3	7.7
Public Safety	1	2.6
Total	**39**	**100.0**

N= Number of Respondent; %= Percentage of Respondent
Source: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Figure 7 Types of Services Provided by the Organizations

5.3 THE PERFORMANCE OF TURKISH DISASTER SYSTEM DURING THE 1999 EARTHQUAKES

In this section of the chapter, I analyze the data primarily collected from interviews to investigate initial conditions of information infrastructure during the 1999 response operations. This analysis consists of three parts: (1) examining the degree of utilization of existing information and communication infrastructure for both earthquakes; and, (2) examining the significance of information exchange among disaster organizations during the earthquakes; and, (3) examining the impact of information infrastructure on the performance of the Turkish disaster system during the earthquakes.

In this part of the study, I also perform a statistical analysis to test the impact of information and communication capacity of the disaster system on the performance of disaster organizations during the Marmara and Duzce earthquakes since I have 19 respondents that were involved in both response systems. I conducted a paired-t test analysis to see whether there is a significant change in information processes from the Marmara response system to the Duzce response system.

5.3.1 Means of Communication and Information during the 1999 Earthquakes

The initial conditions of informational infrastructure are very important for the performance of a disaster system during disaster response operations. The level of information infrastructure inhibits or facilitates the ability to obtain and exchange timely and accurate information for response operations. Availability of means of communication increases information exchange among disaster organizations so that disaster organizations can act upon timely information to respond to a disaster effectively.

Insufficient information and communication capacity of the disaster system constrained timely information gathering and exchange among disaster organizations, especially during the Marmara earthquake.[18] Table 8 shows the availability of means of information and communication technologies during the 1999 response operations.

According to Table 8, most of the organizations (38.7 %) used cell/mobile phones to obtain and exchange the information during the earthquakes. But these were not secure phone lines among disaster organizations. During the first three days of response operations, responsible disaster managers were not able to use these communication means in many disaster-stricken places because the main fiber optic cable between Istanbul and Ankara, and the backbone connections into this region were damaged.[19] The utilization of phones was very limited and far from adequate to establish coordination during the disaster operations (Comfort, 2000).

Another issue was the utilization of advance information and communication tools. According to respondent organizations, utilization of advance information and communication tools was even more limited. Only seven of the 31, or 9.3% of respondents, and three of 15, or 7.5% of respondents, said that they had both Geographic Information Systems (GIS) and Global Positioning Systems (GPS) during the Marmara, and Duzce earthquakes, respectively. However,

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[18] Interview with The Red Crescent Society, June 9, 2004

[19] Interview with Kocaeli Municipality Fire Department, June 16, 2004
Interview with General Directorate of Turkey Emergency Management, June 7, 2004
Interview with Sakarya Crisis Management Center, June 15, 2004

those organizations were primarily research and private organizations.[20] Many organizations that have responsibilities to cope with immediate response operations were not able to utilize these advanced information technologies. Institutions that have GIS (*e.g.* Istanbul Province, GDDA) could not use the system in early days of disaster, since either they did not have trained personnel or the system was still under development (Comfort 2000).

Table 8 Means of Communication/Information

"What kind of information and communication technologies did you use to obtain and transmit information to other organizations involved in the disaster operations process?"						
Means of Communication /Information	Marmara	%	Duzce	%	Total Response	%
GIS	7	9.3	3	7.5	10	8.7
GPS	7	9.3	3	7.5	10	8.7
Computer/Computer Networks	5	6.7	2	5.0	7	6.1
Satellite Phones	5	6.7	3	7.5	8	7.0
Megaphone	5	6.7	0	0.0	5	4.3
Radio/ Amateur radio	1	1.3	1	2.5	2	1.7
Internet	7	9.3	4	10.0	11	9.6
TV	0	0.0	0	0.0	0	0.0
Intelligent Reasoning	1	1.3	0	0.0	1	0.9
Risk Assessment models	0	0.0	0	0.0	0	0.0
Wireless Communication /Walkie-talkie	8	10.7	8	20.0	16	13.9
Cell / mobile Phones	29	38.7	16	40.0	45	39.1
Other (n/a)	8	10.7	4	-	12	-
Total response	75	100.0	40	100.0	115	100.0

N= Number of Respondents; %= Percentage of Respondents
Multiple responses were accepted.
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Amateur radio and wireless communication were more useful to the organizations that worked fundamentally on the streets to manage and coordinate response and recovery

[20] Those organizations are General Directorate of Land Registry and Cadastre, General Directorate of Disaster Affairs, Earthquake Research Center, TUBITAK Marmara Research Center, Bogazici University, Kandilli Observatory, General Directorate of Central Hydraulic Works, General Command of Mapping, and Sayisal Grafik Ltd.

operations.[21] However, only 10.7% respondents said that they were able to use wireless communication. There was only one organization (*e.g.* TRAC) that was able to utilize amateur radio for communication among disaster organizations during the Marmara and Duzce earthquakes.

The important issue is how effectively the organizations were able to use the existing information systems. In some cases, these tools existed, but they were not accessible to responsible managers who manage the response operations. Particularly during the Marmara earthquake, responsible managers had immense difficulties in obtaining information from disaster sites and disseminating this information to rescue groups. According to Table 9, more than half of the organizations (57.1%) used the information and communication technologies at a less than good level during the Marmara response operations. Fourteen, or 40%, of the respondents said that they were not at all able to use them to obtain disaster relevant information from stricken communities and transmit this information to appropriate disaster organizations. Only one interviewee said that they were able to use these technologies to a great extent.[22] The disaster organizations that are responsible for disaster response operations in practice were not able use the information and communication technologies to a good extent.

Reviewing the responses for the Duzce earthquake, one can see clear differences from the Marmara earthquake regarding utilization of existing information infrastructure. Although the organizations in the Duzce response system did not significantly differ from the organizations involved in the Marmara response system in terms of existing information and communication capacity, they were in a better position to utilize these tools effectively. All of the respondents

[21] Interview with Turkish Amateur Radio Club, June 2004
[22] Interview with TUBITAK Marmara Research Center, July 25, 2004

claimed that they used the information and communication technologies at great or good extent.[23]

> "Duzce response operations were not like the Marmara. Communication and coordination were very good. We were able use satellite phones or amateur radio to communicate. Many central organizations were still in the region. I have to say that the Turkish state was here. When the earthquake happened we were ready. In several hours, we were able to reach every corner of Duzce. We had learned from the Marmara."

Table 9 Utilizing IT during the Marmara and Duzce Response Operations

"To what extent did your organizations utilize information and communication means in disaster operations?"						
	Marmara		Duzce		All Earthquakes	
	Responses	%	Responses	%	Responses	%
Great extent	1	2.9	9	31.6	10	18.5
Good extent	5	14.3	10	69.4	15	27.8
Neither good or bad	9	25.7	0	0.0	9	16.7
Less than good	6	17.1	0	0.0	6	11.1
Not at all good	14	40	0	0.0	14	25.9
Total responses	35	100	19	100	54	100

N= Number of Respondents; %= Percentage of Respondents
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

The statistical analysis in Table 10 supports the descriptive analysis. Based on the answers from the 19 respondents, the statistical results show that the difference is significant with a t=7.92 and p-value=0.000 at 5% significance level. When we analyze all data from 35 observations including 16 respondents who did not participate in the Duzce response operations, the result is still statistically significant. In this respect, I examined the extreme possibility that all 16 missing responses were the "worst case" (not at all good). Table 1 (see Appendix D) shows that the difference of means is significant at the 5% significance level, even with the missing data having the extreme value (t=2.04 and p-value=0.025). Thus, there is a statistically

[23] Interview with Duzce Province Government, June 14, 2004

significant increase in utilizing information and communication systems in the response to the Duzce earthquake from the response to the Marmara earthquake.

Table 10 The Paired T-test for Utilizing Information and Communication Means

"To what extent did your organizations utilize information and communication means in disaster operations?"

Paired T test for Duzce and Marmara

	N	Mean	StDev	SE Mean
Duzce	19	4.47368	0.51299	0.11769
Marmara	19	2.42105	1.26121	0.28934
Differences	19	2.05263	1.12909	0.25903

95% lower bound for mean difference: 1.60345
T-Test of mean difference = 0 (vs > 0): T-Value = 7.92 P-Value = 0.000

Source: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

5.3.2 Information Exchange among Disaster Organizations during the Earthquakes

The effective utilization of information and communication technologies for disaster management becomes important since timely information exchange is vital for coordination among disaster organizations. Because of insufficient utilization of appropriate information and communication systems, information exchange was very limited during the Marmara response operations. This situation resulted in uncoordinated actions, especially during the first three days[24].

> "…We were completely unprepared. We were shocked. We did not know where the earthquake hit, or how big the disaster was. Communication was totally collapsed. We reached some villages or small cities after the second or third of day of the earthquake."

[24] Interview with Turkish Red Crescent Society, June 9, 2004

According to Table 11, none of the respondents rated "information exchange" as great for the Marmara response operations while six, or 31.6% of respondents rated it as great for the Duzce response operations. Thirteen of 19 respondents, or 69.4%, claimed that the information exchange between their organization and other organizations was good during the Duzce Earthquake, while only one of the 35 respondents, or 2.9%, said that information exchange was good in the Marmara Earthquake.[25] Twenty two of 35 respondents, or 62.8%, said that information exchange was "less than good" or "not at all good" level during the Marmara earthquake. It is obvious that better utilization of existing information and communication systems positively affected response operations during the Duzce earthquakes.

Table 11 Information Exchange during the 1999 Earthquakes

"To what extent did information exchange exist between your organization and other organizations during response operations?"						
	Marmara		Duzce		All Earthquakes	
	Responses	%	Responses	%	Responses	%
Great extent	0	0.0	6	31.6	6	11.1
Good extent	1	2.9	13	69.4	14	25.9
Neither good nor bad	12	34.3	0	0.0	12	22.2
Less than good	11	31.4	0	0.0	11	20.4
Not at all good	11	31.4	0	0.0	11	20.4
Total responses	35	100	19	100	54	100

N = Number of Respondents; % = Percentage of Respondents
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

The paired t-test analysis in Table 12 shows that information exchange among organizations increased significantly during the Duzce operations. Based on the answers from the 19 respondents, the statistical results indicates that the difference of means is significant with a t=9.87 and p-value=0.000 at 5% significance level. When I include all data from 35 observations including 16 respondents who did not participate in the Duzce response operations,

[25] TUBITAK Marmara Research Center did not have any problems of exchanging information.

the result is still statistically significant. Table 2 (see Appendix D) shows that the difference of means is significant at the 5% significance level even with the missing data having the extreme value (t=2.24 and p-value=0.016). Thus, there is a statistically significant increase in information exchange among disaster organizations in responding to the Duzce earthquake versus those responding to the Marmara earthquake.

Table 12 The Paired T-test for Information Exchange among Disaster Organizations

"To what extent did the information exchange exist between your organization and other organizations during response operations?"

Paired T test for Duzce and Marmara

	N	Mean	StDev	SE Mean
Duzce	19	4.31579	0.47757	0.10956
Marmara	19	2.10526	0.93659	0.21487
Differences	19	2.21053	0.97633	0.22399

95% lower bound for mean difference: 1.82212
T-Test of mean difference = 0 (vs > 0): T-Value = 9.87
P-Value =0.000

Source: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

The lack of an adequate inter-organizational knowledge base was one of the reasons for insufficient information exchange among disaster organizations. Establishing this system before disasters assists organizations in obtaining, disseminating, updating and storing vital information for quick response during any catastrophic event. According to the data (Appendix D, Table 5), many organizations did not have an adequate information infrastructure to create an inter-organizational knowledge base. Only three of 39 respondents[26] said that they were able to use a knowledge base during the Marmara earthquake, while only two of the 19 respondents said they

[26] Interview with TUBITAK Marmara Research Center, July 25, 2004
Interview with Sayisal Grafik Ltd., July 25, 2004
Interview with Japan International Coordination Agency, July 25, 2004

used a knowledge base during the Duzce earthquake. Respondents claimed that an inter-organizational knowledge base would be very beneficial for decision makers, if it was there (see Appendix D, Table 6). One of three respondents said that using an inter-organizational knowledge base did not have a remarkable effect on the performance of the organization during the Marmara response operations while two respondents claimed that an inter-organizational knowledge base was very beneficial. Two respondents said that an inter-organizational knowledge base was utilized effectively during the Duzce operations. These results may indicate the benefits of knowledge base; however, in order to measure the effectiveness of an inter-organizational knowledge base, we should have more organizations in the sample that share a knowledge base with other disaster organizations.

5.3.3 The Impact of Information Infrastructure on the Performance of Disaster System

The ability of the Turkish disaster system to utilize information and communication technologies during the Duzce and Marmara response operations influenced the performance of the system. The system performed disappointingly in the Marmara earthquake, but worked better during the Duzce earthquake (Comfort, 1999; Comfort and Sungu, 2001).

Experts in the Turkish disaster system claimed that information systems provided timely and accurate information during the Duzce operations, whereas the lack of information systems created problems in obtaining timely and accurate information for coordinated actions during the Marmara operations. As shown in Table 13, only three respondents, or 8.6%, believed that existing information infrastructure supported disaster operations with timely and accurate information at great or good extent during the Marmara operations. Twenty-four, or 68.5% of the respondents said that the existing information infrastructure supported disaster operations at less than good or not at all good level during the Marmara response operation. When we add the number of responses indicated neither good nor bad to this category, the proportion group comes to 91.4 %. All of the respondents said that existing information infrastructure capacity provided timely and accurate information to support disaster organizations at either good (47.4%) or great extent (52.6%) during the Duzce earthquake.

Table 13 Effectiveness of Information Systems

"To what extent existing information systems provide timely and accurate information to support disaster organizations during the disaster operations?"

	Marmara		Duzce		All Earthquakes	
	Response	%	Response	%	Response	%
Great extent	1	2.9	10	52.6	11	20.4
Good extent	2	5.7	9	47.4	11	20.4
Neither good or bad	8	22.9	0	0.0	8	14.8
Less than good	11	31.4	0	0.0	11	20.4
Not at all good	13	37.1	0	0.0	13	24.1
Total response	35	100	19	100	54	100.0

%=Percentage of Responses
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Timely and accurate information to support disaster organizations was significantly improved from the Marmara earthquake to the Duzce earthquake, as supported by paired-t test results in Table 14 (t=10.67 and p-value= 0.000), based on 19 observations. When data from 35 observations, including the 16 respondents who did not participate in the Duzce response operations are included in the analysis, the result is still statistically significant at the 5% significance level. Table 3 (see Appendix D) shows that the difference in perceived effectiveness of used information technology between the two earthquakes is significant, even with the missing data having the extreme value (t=2.70 and p-value=0.005). Significant improvement in obtaining timely and accurate information during the Duzce operations increased the performance of disaster organizations.

Table 14 The Paired T-test for Effectiveness of Information Systems

"To what extent did the existing information systems provide timely and accurate information to support disaster organizations during the disaster operations?"				
Paired T test for Duzce and Marmara				
	N	Mean	StDev	SE Mean
Duzce	19	4.52632	0.51299	0.11769
Marmara	19	2.21053	1.08418	0.24873
Differences	19	2.31579	0.94591	0.21701
95% lower bound for mean difference: 1.93949				
T-Test of mean difference = 0 (vs > 0): T-Value = 10.67 P-Value = 0.000				

Source: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Table 15 provides information on the performance of the Turkish disaster system in terms of information infrastructure. The table clearly indicates that the disaster system performed poorly in terms of exchanging disaster relevant information among disaster organizations from different jurisdictions during the Marmara earthquake. None of the respondents rated the overall performance of the Turkish Disaster Management system as great for the Marmara response operations. Only one of them said the performance of the system was good[27] during the Marmara earthquake. Thirty two of the 38 respondents, or 84.2%, claimed that the existing information infrastructure was less than good to support information flow between disaster organizations.

However, from Table 15, we can conclude that this problem was largely solved during the Duzce earthquake. Nine of the 19 respondents, or 47.4% rated the overall performance of existing information and communication capacity of the system as good whereas 52.6 % of them said that existing information and communication capacity was great to support the exchange of

[27] Sayisal Grafik Ltd.

necessary disaster relevant information and resources among local, provincial, and central disaster organizations during the Duzce response operations.

Table 15 The performance of Turkish Disaster System in terms of Information Infrastructure

"How do you rate performance of the information infrastructure in terms of exchanging necessary disaster relevant information and resources with local/provincial/central government?"						
	Marmara		Duzce		All Earthquakes	
	Responses	%	Responses	%	Responses	%
Great extent	0	0.0	10	52.6	10	17.5
Good extent	1	2.6	9	47.4	10	17.5
Neither good or bad	5	13.2	0	0.0	5	8.8
Less than good	16	42.1	0	0.0	16	28.1
Not at all good	16	42.1	0	0.0	16	28.1
Total responses	38	100	19	100	57	100.0

N = Number of Respondents; % = Percentage of Respondents
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

The statistical analysis of paired t-test in Table 16 supports the differences between the two cited response systems above. Based on data from the 19 respondents, the statistical results show that the difference of means is significant with a t=17.05 and p-value=0.000 at 5% significance level. When data from 35 observations including 16 respondents who did not participate in the Duzce response operations are analyzed, the result is still statistically significant. In this respect, I examine the extreme possibility that all 16 missing responses were the "worst case" (not at all good). Table 4 (see Appendix D) shows that the result is significant at the 5% significance level even with the missing data having the extreme value (t=3.10 and p-value=0.002). The performance of the disaster system significantly improved from Marmara to Duzce due to the fact that disaster organizations had a better capability to exchange disaster relevant information.

Table 16 The Paired T-test for The performance of Turkish Disaster System in terms of Information Infrastructure

"How do you rate performance of the information infrastructure in terms of exchanging necessary disaster relevant information and resources with local/provincial/central government?"

Paired T test for Duzce and Marmara

	N	Mean	StDev	SE Mean
Duzce	19	4.52632	0.51299	0.11769
Marmara	19	1.73684	0.65338	0.14989
Differences	19	2.78947	0.71328	0.16364

95% lower bound for mean difference: 2.50571

T-Test of mean difference = 0 (vs > 0): T-Value = 17.05 P-Value = 0.000

Source: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

These analyses show that disaster organizations had difficulties in obtaining timely and accurate information from disaster sites and exchanging this information with other organizations from different jurisdictional and organizational levels during the Marmara response operations. The statistical analysis proves that the disaster system was more effective during the Duzce operations. At this point, we have to acknowledge that the Marmara earthquake was a regional disaster whereas the Duzce earthquake was a local disaster, and it occurred three months after the Marmara earthquake. The disaster organizations were more aware and ready during the Duzce earthquake. Although the utilization of information systems and information exchange was better during the Duzce operations compared to the Marmara operations, the disaster system still needed to be improved. The improvement in information infrastructure started right after the Marmara earthquake, but the system retained deficiencies in terms of necessary information and communication means, and an inter-organizational knowledge base during the Duzce earthquake.

5.4 SUMMARY

In this chapter, I investigated initial conditions of information infrastructure during the 1999 Marmara and Duzce response operations. I primarily used data collected from semi-structured interviews for this analysis. I first described the demographic characteristics of respondent organizations. Then, I examined means of communication and information used in the response operations. I also examined information exchange capacity of the disaster system during the earthquake response operations. Finally, I examined the impact of information infrastructure on the performance of the Turkish disaster system.

In the chapter, I compared the two response systems to determine whether there is a significant difference in the performance of the disaster system from the Marmara to the Duzce earthquake as a result of increasing information exchange capability. The paired t-test along with descriptive analysis showed that the Turkish disaster system learned from the Marmara earthquake and was significantly improved to respond to the Duzce earthquake. Information search, acquisition and exchange were more effective to provide timely and accurate information for coordination of response operations during the Duzce earthquake.

6.0 INTER-ORGANIZATIONAL COORDINATION DURING THE 1999 EARTHQUAKES

6.1 INTRODUCTION

The purpose of this chapter is to explore how the characteristics of organizational networks evolved during the Duzce and Marmara response operations. In the first part of the chapter, I analyze the type of organizations that participated in the response systems. Then, I examine the types of transactions and interactions among these organizations during the Marmara and Duzce response operations. In this part of study, I compare the two response systems based on the transactions conducted during the response operations. The comparison shows differences between the two response systems in terms of utilization of information and communication systems, and local organizations' involvement in response operations. This examination indicates the gaps in the disaster system and provides guidance to close these gaps. Finally, I conduct a social network analysis by using the UCINET network analysis program (Borgatti, Everett, Freeman 2002) to investigate the network relationships of disaster organizations during the 1999 response operations. This analysis reveals differences between the actual response system and the official Turkish disaster management system. Data collected from content analysis of *Cumhuriyet* newspaper for 21 days after the Marmara and Duzce earthquakes were used for these analyses.

6.2 TYPES OF ORGANIZATIONS

In this section, I investigate the organizations that participated in the 1999 response systems. I categorize the organizations based on their jurisdictions and sources of funding. This investigation reveals the characteristics of disaster organizations involved in response systems.

6.2.1 The 1999 Marmara Earthquake

Table 17 shows what types of organizations were involved in the Marmara response system. As shown in Table 17, the proportion of national organizations involved in response operations is very significant. National organizations (293, or 80.05%) clearly played a more important role in response operations than international (73, or 19.95%) organizations.

The frequency distributions of types of organizations confirm the centralized characteristics of Turkish public administration. Public-central organizations play more significant roles than other types of public organizations. Twenty-four percent of all organizations are public-central, while 15.3% and 5.2% of all organizations are public-province and public-municipal organizations, respectively. Only 4.4% of all organizations are public-district organizations.

According to the data indicated in Table 17, more national private organizations are involved in the response operations than a combination of public-district, public-municipal, and nonprofit organizations. Seventy-eight of 366 organizations (21.3%) are national private organizations whereas 71 (19.9%) organizations are public-district, public-municipal, and national nonprofit.

Table 17 Types of organizations in the 1999 Marmara Earthquake

National Organizations	**N**	**%**
Public-Central	88	24
Public-Province	56	15.3
Public-District	16	4.4
Public-Municipal	19	5.2
Nonprofit	36	9.8
Private	78	21.3
Total National	**293**	**80.05**
International Organizations	**N**	**%**
Public-International	52	14.2
Nonprofit-International	13	3.6
Private International	8	2.2
Total International	**73**	**19.95**
Total	**366**	**100.0**

N= Number of Organizations; % = Percentage of Organizations
Source: Modified from Corbacioglu, 2004

6.2.2 The 1999 Duzce Earthquake

Table 18 provides information about organizations that participated in the Duzce response system. According to the table, the national organizations (141, or 77.1%) played a more important role in response operations than international (42, or 22.9%) organizations, as it was in the Marmara earthquake.

The findings are very similar to the Marmara response system. Public organizations were the heart of emergency management for the Duzce response system as well. Approximately 83% of all organizations are national and international public organizations while only 16.4% of them are nonprofit and private organizations. The larger section of public organizations is public-central organizations. Fifty-one, or 27.9% of all organizations that participated in the Duzce response system are public-central organizations, while 25.7% and 7.1% of all organizations are public-province and public-municipal organizations, respectively. Only nine, or 4.9%, of organizations are public-district organizations. Domestic private organizations are less involved (3.8%) in the Duzce response operations than the Marmara response operations (21.3%). National nonprofit organizations (7.7%) are relatively more involved in the Duzce response operations than private organizations. There is no international private organization while there are nine international nonprofit organizations that constitute roughly 5% of the response system.

Table 18 Types of organizations in the 1999 Duzce Earthquake

National Organizations	**N**	**%**
Public-Central	51	27.9
Public-Province	47	25.7
Public-District	9	4.9
Public-Municipal	13	7.1
Nonprofit	14	7.7
Private	7	3.8
Total National	**141**	**77.1**
International Organizations	**N**	**%**
Public-International	33	18
Nonprofit-International	9	4.9
Private International	0	0
Total International	**42**	**22.9**
Total	**183**	**100**

N= Number of Organizations; % = Percentage of Organizations
Source: Modified from Corbacioglu, 2004

In summary, national public organizations constituted a very high proportion of the 1999 response operations. Among public organizations, public-central organizations played significant roles. Public provincial, district and municipal organizations were involved relatively more in the Duzce response operations than in the Marmara response operations. On the other hand, involvement of nonprofit and private organizations in the Marmara response operations was considerably higher than in the Duzce response operations.

6.3 ORGANIZATIONAL INTERACTIONS IN THE 1999 EARTHQUAKES

In this section of the chapter, I classify the types and numbers of organizations involved in the 1999 disaster operations based on the types of transactions and interactions that the organizations made. The patterns that evolved among participating organizations present suggestions for the incentives and restraints on the organizational learning process (Comfort 126, 1999).

Type of Transactions in the Marmara Response Operations\

Table 19 presents quite a large set of 1112 transactions reported for the 1999 Marmara earthquake response system. The largest proportion, 214, or 19.24% of transactions involved disaster relief activities, most of which were initiated by the public-central and public-international organizations. Domestic nonprofit and private organizations were also involved in a considerable number of relief operations. Provincial organizations were involved in 21 disaster relief activities.

The second largest category of reported transactions was donation activities. Public-international and public-central, domestic nonprofit organizations, and domestic private organizations played a considerable role in this category, which registered 106, or 9.53%, of the total transactions.

These categories are followed by medical care/health assistances/medical supplies, 8.18%, and emergency response, 6.74%. Legal issues and legal enforcement comprise 44, or 3.96% transactions that indicate the necessity of a legal reform regarding disaster management. Damage and need assessment for 5.40%, public announcement for 4.77%, recovery/reconstruction for 3.69% are the other important transactions.

Communication activities involved 61, or 5.49 transactions. Regardless of this proportion in communication activities, coordination activities (43 or 3, 87%) do not constitute a notable portion of all transactions. Interestingly, these statistics are less than the ones that represent criticisms of coordination and disaster management performance during the disaster operations (67 or 6.03%). Combined communication and coordination categories compromise 9.36% of the total transactions reported for disaster operations. When we consider the fact that most of the communication activities reported took place after the critical first three days following the earthquake, we can understand how the lack of communication capacity hampered the coordination of disaster operations during the Marmara earthquake.

The data portray a response system largely directed by the central government and provincial government with considerable contributions by international assistance and relatively weak participation at the local level. The analysis shows the system's inability to function without basic assistance from local level disaster agencies. The gap in communication between the national and local levels of governmental agencies adversely impacted interactions among disaster agencies and eventually reduced the performance of the whole response system.

Table 19 Frequency Distributions: Type of transactions in Response Operations by Funding Source and Jurisdictions, Marmara Earthquake, August 17-September 7, 1999

Type of Transactions	Public Organizations															Nonprofit						Private						TOTALS		
	International			Central			Provincial			Disrtrict			Municipal			International			National			International			National					
	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%
Building inspection/Building Codes Issues	0	0	0.0	6	6	0.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.2	0	0	0.0	0	0	0.0	8	8	0.72
Communication	9	9	0.8	22	22	2.0	12	12	1.1	1	1	0.1	2	2	0.2	2	2	0.2	12	12	1.1	0	0	0.0	1	1	0.1	61	61	5.49
Coordination of Response	0	0	0.0	21	21	1.9	10	10	0.9	0	0	0.0	2	2	0.2	0	0	0.0	7	7	0.6	0	0	0.0	3	3	0.3	43	43	3.87
Critics of Disaster Management	1	1	0.1	25	25	2.2	2	2	0.2	0	0	0.0	1	1	0.1	2	2	0.2	36	36	3.2	0	0	0.0	0	0	0.0	67	67	6.03
Damage Assessment/Need Assessment	0	0	0.0	32	32	2.9	15	15	1.3	1	1	0.1	5	5	0.4	1	1	0.1	4	4	0.4	0	0	0.0	2	2	0.2	60	60	5.40
Death Issues/Certification of deaths	1	1	0.1	9	9	0.8	3	3	0.3	0	0	0.0	1	1	0.1	0	0	0.0	1	1	0.1	0	0	0.0	1	1	0.1	16	16	1.44
Debris removal/water supply	2	2	0.2	4	4	0.4	3	3	0.3	1	1	0.1	1	1	0.1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	11	11	0.99
Disaster relief (food, shelter, aids, and etc)	27	26	2.4	51	49	4.6	21	19	1.9	4	4	0.4	15	11	1.3	5	5	0.4	46	42	4.1	2	2	0.2	43	41	3.9	214	199	19.24
Donations/Donation Campaigns/volunteer	24	23	2.2	20	20	1.8	5	5	0.4	1	1	0.1	3	3	0.3	10	10	0.9	19	19	1.7	4	4	0.4	20	20	1.8	106	105	9.53
Earthquake Assessment/Research	1	1	0.1	17	17	1.5	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.2	1	1	0.1	0	0	0.0	0	0	0.0	21	21	1.89
Education Issues	0	0	0.0	8	8	0.7	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	5	5	0.4	0	0	0.0	0	0	0.0	13	13	1.17
Energy Issues	0	0	0.0	10	10	0.9	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	10	10	0.90
Evacuation	0	0	0.0	1	1	0.1	2	2	0.2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	3	3	0.27
Financial Relief/Loan/Tax Relief	5	5	0.4	8	8	0.7	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	6	6	0.5	20	20	1.80
Fire fighting	8	7	0.7	2	2	0.2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	11	10	0.99
Hazardous Materials Releases/Environmental Issues	0	0	0.0	3	3	0.3	9	9	0.8	0	0	0.0	5	5	0.4	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	18	18	1.62
Infrastructure	1	1	0.1	3	3	0.3	0	0	0.0	0	0	0.0	1	1	0.1	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	6	6	0.54
Logistic	2	2	0.2	8	8	0.7	5	5	0.4	0	0	0.0	5	5	0.4	0	0	0.0	0	0	0.0	0	0	0.0	4	3	0.4	24	23	2.16
Legal Issues/legislation/Legal Enforcement	0	0	0.0	29	29	2.6	4	4	0.4	1	1	0.1	0	0	0.0	0	0	0.0	10	10	0.9	0	0	0.0	0	0	0.0	44	44	3.96
Medical Care/Health Assistances/Medical Supplies	18	17	1.6	21	21	1.9	20	18	1.8	1	1	0.1	1	1	0.1	1	1	0.1	17	15	1.5	0	0	0.0	12	12	1.1	91	86	8.18
Official Visit	5	5	0.4	10	10	0.9	0	0	0.0	0	0	0.0	1	1	0.1	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	17	17	1.53
Proposal for Permanent Housing/urban development	0	0	0.0	10	10	0.9	0	0	0.0	0	0	0.0	2	2	0.2	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	13	13	1.17
Physiological and Spiritual Counseling/Child Care	0	0	0.0	10	10	0.9	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.1	9	9	0.8	0	0	0.0	3	3	0.3	23	23	2.07
Public announcement/expression of condolence	5	5	0.4	33	33	3.0	6	6	0.5	4	4	0.4	1	1	0.1	1	1	0.1	2	2	0.2	0	0	0.0	1	1	0.1	53	53	4.77
Reconstruction/Recovery/Repair	2	2	0.2	16	16	1.4	1	1	0.1	0	0	0.0	5	5	0.4	1	1	0.1	12	12	1.1	1	1	0.1	3	3	0.3	41	41	3.69
Search and Rescue	26	21	2.3	24	24	2.2	7	6	0.6	0	0	0.0	6	6	0.5	0	0	0.0	5	5	0.4	0	0	0.0	7	5	0.6	75	67	6.74
Security Issues	0	0	0.0	6	6	0.5	6	6	0.5	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	13	13	1.17
Transportation/Traffic Issues	0	0	0.0	5	5	0.4	1	1	0.1	0	0	0.0	2	2	0.2	0	0	0.0	1	1	0.1	1	1	0.1	4	4	0.4	14	14	1.26
Warning	0	0	0.0	13	13	1.2	2	2	0.2	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	16	16	1.44
Total	137	128	12.3	427	425	38.4	134	129	12.1	14	14	1.3	59	55	5.3	27	27	2.4	196	190	17.6	8	8	0.7	110	105	9.9	1112	1081	100.00

N=Number of Organizations; T=Number of Transactions; %=Percentage of Transactions

Sources: *Cumhuriyet* news reports, August 17 - September 7, 1999 (Corbacioglu, 2004)

6.3.1 Types of Transactions in the Duzce Response Operations

Table 20 presents a relatively small set of 274 transactions reported for the 1999 Duzce earthquake response system. The largest proportion, 69, or 25.18.4%, involved disaster emergency response activities, most of which were initiated by public organizations. Public-international, public-provincial and public-central agencies played important roles in emergency response operations. The second largest category of reported transactions was disaster relief activities (45, or 16.42%). Public international, domestic nonprofit organizations played considerable roles in this category. The table shows that the transactions involving communication activities compromised 18, or 6.37% of the total number, and the transactions involving coordination constituted 16, or 5.84%. If we consider the statistics of official visit as part of communication and coordination activities that the total number would make up 45, or 16.42%. As a result of increasing coordination activities, the number of critics of disaster management performance decreased from 6.03% to 3.28%.

These categories were followed by medical care/health assistances/medical supplies, 8.9%, donations, 5.2%, and earthquake assessment and research activities, 3.2%. According to the data, there were not many administrative and legal issues that constrained the performance of disaster organizations.

Table 20 Frequency Distributions: Type of transactions in Response Operations by Funding Source and Jurisdictions, Duzce Earthquake, November 12-Decemebr 1, 1999

Type of Transactions	Public Organizations															Nonprofit						Private						TOTALS		
	International			Central			Provincial			Disrtrict			Municipal			International			National			International			National					
	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%
Building inspection/Building Codes Issues	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.36
Communication	3	3	1.1	9	9	3.3	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	3	3	1.1	0	0	0.0	2	2	0.7	18	18	6.57
Coordination of Response	0	0	0.0	13	13	4.7	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.7	0	0	0.0	0	0	0.0	16	16	5.84
Critics of Disaster Management	0	0	0.0	4	4	1.5	3	3	1.1	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.7	0	0	0.0	0	0	0.0	9	9	3.28
Damage Assessment/Need Assessment	0	0	0.0	4	4	1.5	2	2	0.7	1	1	0.4	2	2	0.7	0	0	0.0	2	2	0.7	0	0	0.0	0	0	0.0	11	11	4.01
Death Issues/Certification of deaths	0	0	0.0	3	3	1.1	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	4	4	1.46
Debris removal/water supply	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.73
Disaster relief (food, shelter, aids, and etc)	21	17	7.7	3	3	1.1	5	3	1.8	1	1	0.4	2	2	0.7	0	0	0.0	10	9	3.6	0	0	0.0	3	2	1.1	45	37	16.42
Donations/Donation Campaigns/volunteer	0	0	0.0	0	0	0.0	6	6	2.2	0	0	0.0	0	0	0.0	1	1	0.4	2	2	0.7	0	0	0.0	0	0	0.0	9	9	3.28
Earthquake Assessment/Research	0	0	0.0	7	7	2.6	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	8	8	2.92
Education Issues	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.36
Evacuation	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.36
Financial Relief/Loan/Tax Relief	2	2	0.7	1	1	0.4	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	4	4	1.46
Logistic	0	0	0.0	1	1	0.4	3	3	1.1	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	4	4	1.46
Legal Issues/legislation/Legal Enforcement	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	1	1	0.4	3	3	1.09
Medical Care/Health Assistances/Medical Supplies	7	5	2.6	11	11	4.0	10	7	3.6	0	0	0.0	3	2	1.1	0	0	0.0	4	4	1.5	0	0	0.0	0	0	0.0	35	29	12.77
Official Visit	3	3	1.1	8	8	2.9	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	11	11	4.01
Physiological and Spiritual Counseling/Child Care	1	1	0.4	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.73
Public announcement/expression of condolence	1	1	0.4	5	5	1.8	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.4	8	8	2.92
Reconstruction/Recovery/Repair	1	1	0.4	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.73
Search and Rescue	35	30	12.8	12	12	4.4	14	10	5.1	0	0	0.0	5	3	1.8	0	0	0.0	3	3	1.1	0	0	0.0	0	0	0.0	69	58	25.18
Transportation/Traffic Issues	0	0	0.0	2	2	0.7	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	4	4	1.46
Warning	0	0	0.0	7	7	2.6	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	7	7	2.55
Total	74	63	27.0	95	95	34.7	49	40	17.9	4	4	1.5	14	11	3.2	1	1	0.4	30	29	10.9	0	0	0.0	7	6	2.6	274	249	100.00

N=Number of Organizations; T=Number of Transactions; %=Percentage of Transactions

Sources: *Cumhuriyet* news reports, November 12 - December 1, 1999 (Corbacioglu, 2004)

6.3.2 Assessment of Emergency Support Functions

In this section of the study, I compare the two response systems based on the transactions reported. In order to do this comparison, I categorize transactions based on emergency support functions (ESF)[28] (FEMA, 2006) and previous studies (Comfort, 1999)[29]. Hence, I combine the transactions under 15 functions. Table 21 and 22 present the data of emergency response functions for the Marmara and Duzce response systems.

As shown in Table 21, disaster relief and human service activities compose of the largest number of transactions, 361, or % 32.46% in the Marmara response system. The functions of health and medical care, 93, or 8.36%, search and rescue, 89, or 8.0%, and public information, 85, or 7.64% follow disaster relief and human services. According to Table 21, communication activities compromise 63, or 5.67% of total transactions whereas coordination of response constitutes 39, or 3.51%. Consistent with Table 19, Table 21 shows that critical assessment of disaster management performance compromise larger number, 67, or 6.03%. This result indicates deficiencies in communication channels that affected coordination of response operations which was highly criticized by public during the Marmara earthquake.

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[28] FEMA identified 15 emergency supprt functions for federal response plan. These are the basis functions. Based on the specific conditions of risk prone areas, state, or county governments use the ESfs in conjunction with more ESFs to operate a response to a particular event.
[29] In her book, Comfort investigated the 1992 Erzincan response system. I utilized this research to identify the specific circumstances for the Turkish disaster response system.

Table 21 Frequency Distributions: Emergency Support Function in Disaster Response Operations by Funding Source and Jurisdiction, Marmara Earthquake, August 17-September 7, 1999

Type of Transactions	Public Organizations															Nonprofit						Private						TOTALS		
	International			State			Provincial			Disrtrict			Municipal			International			National			International			National					
	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%
Communication	8	8	0.7	32	32	2.9	9	9	0.8	0	0	0.0	3	3	0.3	2	2	0.2	8	8	0.7	0	0	0.0	1	1	0.1	63	63	5.67
Coordination of response	0	0	0.0	20	20	1.8	10	10	0.9	0	0	0.0	0	0	0.0	0	0	0.0	6	4	0.5	0	0	0.0	3	2	0.3	39	36	3.51
Critical assessment of DM performance	1	1	0.1	25	25	2.2	2	2	0.2	0	0	0.0	1	1	0.1	2	2	0.2	36	36	3.2	0	0	0.0	0	0	0.0	67	67	6.03
Damage assessment	0	0	0.0	30	30	2.7	11	11	1.0	1	1	0.1	4	4	0.4	2	2	0.2	3	3	0.3	0	0	0.0	1	1	0.1	52	52	4.68
Disaster relief/human services	55	50	4.9	85	84	7.6	28	26	2.5	5	5	0.4	18	15	1.6	14	14	1.3	81	81	7.3	6	6	0.5	69	66	6.2	361	347	32.46
Financial Assistance	5	5	0.4	8	8	0.7	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.1	1	1	0.1	0	0	0.0	4	4	0.4	19	19	1.71
Health and Medical Care	18	16	1.6	25	24	2.2	19	17	1.7	0	0	0.0	2	2	0.2	1	1	0.1	16	12	1.4	0	0	0.0	12	12	1.1	93	84	8.36
Legal issues/legal enforcement	0	0	0.0	35	35	3.1	12	12	1.1	1	1	0.1	0	0	0.0	0	0	0.0	10	10	0.9	0	0	0.0	0	0	0.0	58	58	5.22
Post-disaster research	0	0	0.0	25	25	2.2	1	1	0.1	0	0	0.0	0	0	0.0	1	1	0.1	1	1	0.1	0	0	0.0	0	0	0.0	28	28	2.52
Public information	7	7	0.6	43	43	3.9	16	16	1.4	6	6	0.5	2	2	0.2	2	2	0.2	7	7	0.6	0	0	0.0	2	2	0.2	85	85	7.64
Public works and engineering	2	2	0.2	26	26	2.3	12	12	1.1	1	1	0.1	7	7	0.6	0	0	0.0	5	5	0.4	0	0	0.0	0	0	0.0	53	53	4.77
Recovery/Reconstruction	3	3	0.3	32	32	2.9	1	1	0.1	0	0	0.0	10	10	0.9	2	2	0.2	14	14	1.3	1	1	0.1	4	4	0.4	67	67	6.03
Resource Support	3	3	0.3	9	9	0.8	5	5	0.4	0	0	0.0	5	5	0.4	0	0	0.0	1	1	0.1	0	0	0.0	4	3	0.4	27	26	2.43
Search and Rescue	35	33	3.1	27	27	2.4	8	7	0.7	0	0	0.0	6	5	0.5	0	0	0.0	7	7	0.6	0	0	0.0	6	6	0.5	89	85	8.00
Transportation	0	0	0.0	5	5	0.4	0	0	0.0	0	0	0.0	1	1	0.1	0	0	0.0	0	0	0.0	1	1	0.1	4	4	0.4	11	11	0.99
Total	137	128	12.3	427	425	38.4	134	129	12.1	14	14	1.3	59	55	5.3	27	27	2.4	196	190	17.6	8	8	0.7	110	105	9.9	1112	1081	100.00

N=Number of Organizations; T=Number of Transactions; %=Percentage of Transactions

Sources: *Cumhuriyet* news reports, August 17 - September 7, 1999 (Corbacioglu, 2004)

Table 22 Frequency Distributions: Emergency Support Functions in Disaster Response Operations by Funding Source and Jurisdiction, Duzce Earthquake, November 12-December 1, 1999

Type of Transactions	Public Organizations															Nonprofit						Private						TOTALS		
	International			State			Provincial			Disrtrict			Municipal			International			National			International			National					
	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%	T	N	%
Communication	6	6	2.2	23	23	8.4	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.7	0	0	0.0	2	2	0.7	34	34	12.41
Coordination of response	0	0	0.0	13	13	4.7	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	15	15	5.47
Critical assessment of DM performance	0	0	0.0	4	4	1.5	3	3	1.1	0	0	0.0	0	0	0.0	0	0	0.0	2	2	0.7	0	0	0.0	0	0	0.0	9	9	3.28
Damage assessment	0	0	0.0	5	5	1.8	3	3	1.1	1	1	0.4	2	2	0.7	0	0	0.0	2	2	0.7	0	0	0.0	0	0	0.0	13	13	4.74
Disaster relief/human services	24	19	8.8	5	5	1.8	14	11	5.1	1	1	0.4	2	2	0.7	1	1	0.4	14	13	5.1	0	0	0.0	3	2	1.1	64	54	23.36
Financial Assistance	2	2	0.7	1	1	0.4	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	4	4	1.46
Health and Medical Care	4	3	1.5	10	10	3.6	5	4	1.8	0	0	0.0	3	2	1.1	0	0	0.0	4	4	1.5	0	0	0.0	0	0	0.0	26	23	9.49
Legal issues/legal enforcement	0	0	0.0	2	2	0.7	2	2	0.7	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	1	1	0.4	6	6	2.19
Post-disaster research	1	1	0.4	6	6	2.2	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	7	7	2.55
Public information	0	0	0.0	9	9	3.3	0	0	0.0	2	2	0.7	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.4	13	13	4.74
Public works and engineering	1	1	0.4	1	1	0.4	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	3	3	1.09
Recovery/Reconstruction	1	1	0.4	1	1	0.4	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	3	3	1.09
Resource Support	0	0	0.0	1	1	0.4	4	4	1.5	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	5	5	1.82
Search and Rescue	35	30	12.8	13	13	4.7	14	9	5.1	0	0	0.0	5	3	1.8	0	0	0.0	3	3	1.1	0	0	0.0	0	0	0.0	70	58	25.55
Transportation	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0	1	1	0.4	0	0	0.0	0	0	0.0	2	2	0.73
Total	74	63	27.0	95	95	34.7	49	40	17.9	4	4	1.5	14	11	5.1	1	1	0.4	30	29	10.9	0	0	0.0	7	6	2.6	274	249	100.00

N=Number of Organizations; K=Number of Interactions; %=Percentage of Interactions
Source: *Cumhuriyet* news reports, November 12 - December 1, 1999 (Corbacioglu, 2004)

Table 22 provides data to compare the Duzce response system to see whether improvements in communication increased coordination of response operations. As indicated in Table 22, the largest proportion of emergency support functions involved search and rescue efforts, 70, or 25.55%, that shows an increase from 8.0%.Disaster relief activities follow search and rescue, 64, or 23.36% that shows an approximately 10% drop from the Marmara response system. These reported transactions shows that organizations were more effective in search and rescue activities. Table 22 reveals the reasons for this effectiveness of the Duzce response system.

According to Table 22, communication functions constitute 34, or 12.41%, while coordination of response functions constitutes 15, or 5.47%, of all transactions. Communication functions during the Duzce operations doubled communication functions during the Marmara operations that eventually raised coordination of response operations from 3.51% to 5.47%. As a result, critical assessment of disaster management performance decreased from 6.03% to 3.28%. Are these results statistically significant to state that improvements in communication and coordination activities fostered a better environment to manage disaster operations?

6.3.3 Increases in the Turkish Disaster Management Performance

In this section, I employed two population proportions tests to determine whether there is a significant increase in communication, coordination, search and rescue functions, and a significant decrease in disaster relief, and critical assessment of disaster management performance transactions from the Marmara to Duzce response system.

I have two different response systems that are composed of different number of transactions. The differences between the numbers of transactions are significant. The Marmara response system has four times more transactions than the Duzce response system. Therefore, I decided to compare proportions of ESFs rather than the number of ESFs and used “two population proportions test” (two sample z-test). In two population proportions test, I compared the proportion of ESFs for the Marmara response system that has a specified attribute (*e.g.* communication) to the proportion of the ESFs for the Duzce response system that has the specified attribute (*e.g.* communication). Before using this method, I checked the three assumptions required to use “two sample z-test”: simple random samples, independent samples,x_1,n_1-x_1, x_2, and n_2-x_2 are all 5 or greater (Weiss, 2005)[30]. Four of fifteen ESFs, transportation, recovery/reconstruction, public works and engineering, and financial assistance do not support third assumptions due to small number of cases. Therefore, I ran “two population proportion hypothesis” test for remaining 11 ESFs. The detailed test results are listed in Appendix J.

As shown in Table 23, there is a significant difference in communication, coordination of response, and search and rescue activities between the Marmara and Duzce response systems. According to the results in the table, the differences of communication proportion is significant at the 1% significance level with a z=3.92, and p-value=0.000 at 1% significant level. Therefore communication activities increased significantly. Table 23 presents that coordination of response function has a z=1.52, p-value=0.066 that is slightly more than 5% significant level, but it is strongly significant at 10% significant level. Finally, Table 23 shows that proportion of search and rescue increased significantly, with a z=8.16, and p-value=0.00, at 1% significant level.

[30]X=number of successes (e.g. number of communication)
n=sample size (e.g. “n” for the Duzce is 274)

Table 23 Two Population Proportions Test for Communication, Coordination of Response and Search and Rescue

Communication

Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of communication for the Marmara and Duzce is equal)

$H_a : p_1 < p_2$ (percentage of communication for the Duzce is more than for the Marmara)

Sample	X	N	Sample p
1	34	274	0.124088
2	63	1112	0.056655

Difference = p (1) - p (2)
Estimate for difference: 0.0674329
95% lower bound for difference: 0.0327448
Test for difference = 0 (vs > 0): Z = 3.92 P-Value = 0.000

Coordination of response

Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of coordination of response for the Marmara and Duzce is equal)

$H_a : p_1 < p_2$ (percentage of coordination of response for the Duzce is more than for the Marmara)

Sample	X	N	Sample p
1	15	274	0.054745
2	39	1112	0.035072

Difference = p (1) - p (2)
Estimate for difference: 0.0196726
95% lower bound for difference: -0.00468531
Test for difference = 0 (vs > 0): Z = 1.51 P-Value = 0.066

Search and rescue

Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of search and rescue for the Marmara and Duzce is equal)

$H_a : p_1 < p_2$ (percentage of search and rescue for the Duzce is more than for the Marmara)

Sample	X	N	Sample p
1	70	274	0.255474
2	89	1112	0.080036

Difference = p (1) - p (2)
Estimate for difference: 0.175438
95% lower bound for difference: 0.130081
Test for difference = 0 (vs > 0): Z = 8.16 P-Value = 0.000

Table 24 Two Population Proportions Test for Communication, Coordination of Response and Search and Rescue

Disaster relief/human services

Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of disaster relief/human services for the Marmara and Duzce is equal)

$H_a : p_1 > p_2$ (percentage of disaster relief/human services for the Duzce is less than for the Marmara)

Sample	X	N	Sample p
1	64	274	0.233577
2	361	1112	0.324640

Difference = p (1) - p (2)
Estimate for difference: -0.0910636
95% upper bound for difference: -0.0430937
Test for difference = 0 (vs < 0): Z = -2.93 P-Value = 0.002

Critical assessment of disaster management performance

Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of critical assessment of disaster management performance for the Marmara and Duzce is equal)

$H_a : p_1 > p_2$ (percentage of critical assessment of disaster management performance for the Duzce is less than for the Marmara)

Sample	X	N	Sample p
1	9	274	0.032847
2	67	1112	0.060252

Difference = p (1) - p (2)
Estimate for difference: -0.0274051
95% upper bound for difference: -0.00615783
Test for difference = 0 (vs < 0): Z = -1.78 P-Value = 0.037

Legal issues/legal enforcement

Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of legal issues/legal enforcement for the Marmara and Duzce is equal)

$H_a : p_1 < p_2$ (percentage of legal issues/legal enforcement for the Duzce is more than for the Marmara)

Sample	X	N	Sample p
1	6	274	0.021898
2	58	1112	0.052158

Difference = p (1) - p (2)
Estimate for difference: -0.0302605
95% upper bound for difference: -0.0120458
Test for difference = 0 (vs < 0): Z = -2.14 P-Value = 0.016

Table 24 presents the statistical analysis that show which ESFs decreased from the Marmara to the Duzce response system. According to Table 24, the proportion of disaster relief and human services activities significantly decreased in the Duzce response system. This is due to the fact that more search and rescue transactions were reported during the first three days following the Duzce earthquake, whereas more disaster relief activities were reported after the first three days following the Marmara earthquake. Increasing coordination of response operations and search and rescue activities, especially in the first three days following the Duzce earthquake, decreased the critics of disaster management performance. According to the table, at the 5% significant level, critical assessment of disaster management performance decreased significantly during the Duzce earthquake (z=-1.78, p-value=0.037). Finally, legal issues and legal enforcement activities dropped significantly during the Duzce response operations (z=-2.14, p-value=0.016).

This statistical analysis indicates that increasing communication activities increased coordination of response operations, and thus created a more effective search and rescue operations during the Duzce earthquake. Better coordinated, effective response operations decreased criticisms from the public and produced less legal enforcement issues.

6.3.4 Types of Interactions in the Marmara and Duzce Response Operations

In this part of the study, I analyze the frequencies of interactions among disaster organizations during the Marmara and Duzce response operations. This analysis provides information to what extent disaster organizations from different jurisdictions interacted with each other. Table 25 and 26 present this information. The column-total presents the number of interactions (K) that all organizations from a jurisdictional level initiated. The row-total presents the number of organizational interactions for a specific jurisdictional level initiated by other jurisdictional organizations.

Table 25 presents a total of 514 interactions reported among the participating organizations in the Marmara response system. The number of interactions and the number of organizations engaged in cooperative operations illustrate the form of interconnectedness of the response system. The findings show that the vast proportion of interactions, 493, or 95.9% was initiated by public agencies, and within that proportion, the largest component is public-central organizations (229 of a total 493). The second largest number of interactions, 120, or 23.3.1%, was initiated by the set of public-provincial organizations. International public organizations initiated 109, or 21.2% of interactions. Local level organizations, public-district and municipal organizations, initiated 35, or 6.8% of the interactions, reported for disaster response operations.

When we closely look at the table, we can observe that public-central organizations were the centers of interactions. Eighty-eight of 514 total transactions (17.1%) occurred between public-central and public-provincial organizations, whereas 80 of the interactions (15.6%) were between public-central and public international organizations. A total number of 309 (229+80), or 60.1% interactions involved public-central agencies. As consistent with the transaction data, public-district and municipal organizations involved fewer collaborative operations. Most of the interactions involved public-central and provincial organizations. There were only two interactions reported that show public-district and municipal organizations cooperated with agencies from the same jurisdictional level.

Table 25 Frequency Distributions: Types of interactions in Disaster Response Operations by Funding Source and Jurisdiction, Marmara Earthquake, August 17-September 7, 1999

Type of Interactions	Public Organizations															Nonprofit						Private			TOTALS		
	International			Central			Provincial			Disrtrict			Municipal			International			National			National					
	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%
Public-International	5	13	1.0	80	83	15.6	10	11	1.9	3	3	0.6	5	5	1.0	3	3	0.6	3	3	0.6	0	0	0.0	109	121	21.2
Public-Central				64	72	12.5	88	152	17.1	17	18	3.3	9	9	1.8	13	13	2.5	29	29	5.6	9	9	1.8	229	302	44.6
Public-Provincal							37	39	7.2	9	11	1.8	12	15	2.3	2	2	0.4	23	25	4.5	37	51	7.2	120	143	23.3
Public-District										2	2	0.4	2	2	0.4	4	5	0.8	9	10	1.8	12	15	2.3	29	34	5.6
Publical-Municipal																			4	4	0.8	2	9	0.4	6	13	1.2
Nonprofit-International																			2	3	0.4	1	1	0.2	3	4	0.6
Nonprofit-National																			10	17	1.9	7	7	1.4	17	24	3.3
Private																						1	2	0.2	1	2	0.2
Total	5	13	1.0	144	155	28.0	135	202	26.3	31	34	6.0	28	31	5.4	22	23	4.3	80	91	15.6	69	94	13.4	514	643	100.0

N=Number of Organizations; K=Number of Interactions; %=Percentage of Interactions
Sources: *Cumhuriyet* news reports, August 17 - September 7, 1999 (Corbacioglu, 2004)

Table 26 Frequency Distributions: Types of interactions in Disaster Response Operations by Funding Source and Jurisdiction, Duzce Earthquake, November 12-December 1, 1999

Type of Interactions	Public Organizations															Nonprofit						Private			TOTALS		
	International			Central			Provincial			Disrtrict			Municipal			International			National			National					
	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%	K	N	%
Public-International	0	0	0.0	42	43	22.0	0	0	0.0	14	15	7.3	4	4	2.1	0	0	0.0	1	1	0.5	1	1	0.5	62	64	32.5
Public-Central				20	22	10.5	17	24	8.9	19	24	9.9	2	2	1.0	1	1	0.5	4	4	2.1	0	0	0.0	63	77	33.0
Public-Provincal							16	27	8.4	16	16	8.4	8	12	4.2	0	0	0.0	9	10	4.7	1	3	0.5	50	68	26.2
Public-District													6	7	3.1	0	0	0.0	7	10	3.7	1	1	0.5	14	18	7.3
Publical-Municipal													0	0	0.0	0	0	0.0	1	1	0.5	0	0	0.0	1	1	0.5
Nonprofit-International																0	0	0.0	0	0	0.0	0	0	0.0	0	0	0.0
Nonprofit-National																			1	1	0.5	0	0	0.0	1	1	0.5
Private																						0	0	0.0	0	0	0.0
Total	0	0	0.0	62	65	32.5	33	51	17.3	49	55	25.7	20	25	10.5	1	1	0.5	23	27	12.0	3	5	1.6	191	229	100.0

N=Number of Organizations; K=Number of Interactions; %=Percentage of Interactions
Sources: *Cumhuriyet* news reports, November- December 1, 1999 (Corbacioglu, 2004)

Table 26 presents a total 191 interactions reported among the participating organizations during the Duzce response operations. The matrix of interactions indicates a measure of density of the Turkish disaster system in responding to the Duzce earthquake. The table shows a relatively lower level of total interactions compared to the Marmara response system. Because the Duzce earthquake affected a small geographic area with a small population, this result appears reasonable. A total number of 229 organizations participated in these interactions.

The findings show that the immense proportion of interactions, 191, or 99.9% was initiated by public agencies, and within that proportion, the largest component is public-central organizations (63 of a total 191). The second largest number of interactions, 62, or 32.5%, was initiated by the international of public organizations, whereas 50, or 26.2%, were initiated by the set of public-provincial organizations. Local level organizations, public-district and municipal organizations, initiated 15, or 7.8% of the interactions, reported for disaster response operations.

In terms of the performance of nonprofit organizations, there was a decrease of involvement of national and international nonprofit organizations in interactions from the Marmara to Duzce. These organizations participated in 102, or 19.9%, of interactions initiated by public agencies during the Marmara earthquake (see Table 25), whereas nonprofit organizations engaged in 24, or, 12.5%, of interactions during the Duzce earthquake (see Table 26).

Frequencies distributions of interactions in both response systems reveal similar results in terms of which organizations initiated interactions. In the two response systems, public-central, public-international and public-provincial organizations initiated a vast proportion of all interactions. Public-district and public-municipal organizations initiated less than 10% of all interactions (there was a 1% increase in the Duzce response system). However, when we analyze the data on the column total, we can see the differences between the Marmara and Duzce.

The findings display a notable shift to local level agencies for performing a recognized set of tasks in disaster operations. According to Table 26, public-district organizations were involved in 49, or 25.7% of interactions, initiated by public-central, provincial, international organizations. These data illustrates an approximately 20% of increase from the Duzce to Marmara response system (25.7%-6.0%). Likewise, there was an increase of involvement from public-municipal level. During the Duzce response operations, public-municipal organizations engaged in 20, or 10.5% of interactions initiated by public-central, provincial, district, and international organizations that represent a 4.9% of increase from the Marmara to Duzce response system. These results support the statistical analysis of ESFs. The significant influences of enhanced communication and coordination resulted in more local involvement in the Duzce disaster operations.

The interactions analyses portray two response systems, largely directed by the central government, with considerable contributions from provincial governments, international organizations. According to the findings, the Turkish disaster management system was more adaptive and relatively successful in responding to the Duzce earthquake. Better communication and coordination activities resulted in more involvement from local organizations and created faster and better coordinated response operations. However, the performance of the disaster system during the Duzce earthquake does not assure a sufficient disaster system to deal with a bigger and regional disaster such as the Marmara earthquake.

6.4 SOCIAL NETWORK ANALYSIS OF ORGANIZATIONAL NETWORK IN RESPONSE OPERATIONS

In this section of the chapter, I employ the UCINET (Borgatti, Everett, Freeman 2002) social network analysis program to examine the network relationships between disaster organizations involved in the 1999 Marmara and Duzce response systems. Individual disaster organizations from different jurisdictions were involved in response operations to different degrees. Some organizations that are legally responsible for disaster affairs such as crisis management centers performed important roles. Some organizations that are not included in the official disaster management structure such as TRAC played very important roles as well. The position of organizations during response operations indicates the importance of these organizations and the tasks that they carry out. The network analysis illustrates the extent to which the official disaster management structure works in a practical disaster environment.

6.4.1 Centrality Measures for Interactions

Centrality measurements from UCINET (Borgatti, Everett, Freeman 2002) show the positional advantage of the organizations during the response operations. I use binary measurements to code relations among disaster organizations. Relations (ties) being absent are coded (0), whereas relations being present are coded (1). I utilize four basic centrality measurements that UCINET provides (Hanneman 2001). These are: (1) Degree Centrality, (2) Closeness Centrality, (3) Betweenness Centrality, and (4) Flow Betweenness Centrality.

6.4.1.1 Degree Centrality

The measurement of Freeman's degree centrality indicates which organizations have the greatest number of connections to others. The total number of degrees indicates how many connections one organization has with others in the network. It is the sum of Out-Degree and In-Degree data. Out-Degree data shows how many ties an organization sends to others. In-Degree data shows how many ties an organization receives from others. If the organization initiates interactions, and ties with others, its Out-Degree value becomes higher. If the organization is the recipient of an interaction, its In-Degree value grows larger.

According to degree centrality data in Table 27 crisis management centers were the central organizations during the Marmara response operations (see Appendix E, Table 1 for degree centrality of all organizations). Kizilay (actor #7), Interior Ministry (actor #3), Prime Ministry Crisis Management Center (actor #1), Military (actor #5), National Educational Ministry (actor #83), and Health Ministry (actor #4) were the most influential organizations in terms of out-degree centrality. The Kocaeli Crisis Management Center (actor #13), Yalova Crisis Management Center (actor # 11), Sakarya Crisis Management Center (actor #14), Bolu Crisis Management Center (actor# 9), and Istanbul Crisis Management Center (actor #12) were the most influential organizations in terms of in-degree and total degree centrality measurements. Kizilay was the only national nonprofit organization that was very active and influential.

Freeman's degree centrality shows that provincial crisis management centers have larger in-degree centrality than other organizations, but they do not have significant out-degree centrality. Provincial and local organizations operated as centers for collecting incoming assistance and distributing it to needy communities. In contrast, central organizations have larger out-degree centrality since they operated as centers for sending resources via city crisis management centers.

Table 27 Freeman's Degree Centrality for the Marmara Response System

Actor#		OutDegree	InDegree	NrmOutDeg	NrmInDeg
13	KOCMC	17.000	49.000	2.560	7.380
1	PMCMC	21.000	25.000	3.163	3.765
14	YACMC	4.000	42.000	0.602	6.325
11	SACMC	3.000	42.000	0.452	6.325
9	BOCMC	10.000	31.000	1.506	4.669
12	ISCMC	6.000	27.000	0.904	4.066
7	Kizilay	26.000	6.000	3.916	0.904
5	Military	18.000	12.000	2.711	1.807
3	Interior M.	22.000	1.000	3.313	0.151
83	National Education M.	13.000	2.000	1.958	0.301

DESCRIPTIVE STATISTICS

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
		------------	------------	------------	------------
1	Mean	2.410	2.410	0.363	0.363
2	Std Dev	4.018	7.032	0.605	1.059
3	Sum	400.000	400.000	60.241	60.241
4	Variance	16.145	49.447	0.366	1.122
5	SSQ	3644.000	9172.000	82.650	208.031
6	MCSSQ	2680.145	8208.145	60.789	186.170
7	Euc Norm	60.366	95.771	9.091	14.423
8	Minimum	0.000	0.000	0.000	0.000
9	Maximum	26.000	49.000	3.916	7.380

Network Centralization (Outdegree) = 3.596%
Network Centralization (Indegree) = 7.102%

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
KOCMC: Kocaeli Crisis Management Center
SACMC: Sakarya Crisis Management Center
YACMC: Yalova Crisis Management Center
PMCM : Prime Ministry Crisis Management Center
BoCMC: Bolu Crisis Management Center
ISCMC: Istanbul Crisis Management Center
National Education M.: National Education Ministry
Regional CMC: Regional Crisis Management Center
Health M. : Health Ministry
GOLCMC : Golcuk Crisis Management Center

Sources: *Cumhuriyet* news reports, August 17 - September 7, 1999 (Corbacioglu, 2004)

Table 28 Freeman's Degree Centrality for the Duzce Response System

Actor#		OutDegree	InDegree	NrmOutDeg	NrmInDeg
3	Duzce CMC	0.000	59.000	0.000	9.105
2	Bolu CMC	2.000	19.000	0.309	2.932
33	Health M.	13.000	0.000	2.006	0.000
16	Military	10.000	7.000	1.543	1.080
54	Kizilay	9.000	1.000	1.389	0.154
1	PMCMC	6.000	2.000	0.926	0.309
38	Istanbul P.	5.000	2.000	0.772	0.309
24	MTS	6.000	0.000	0.926	0.000
25	D.P.Safety	6.000	0.000	0.926	0.000
60	Prime Ministry	5.000	1.000	0.772	0.154

DESCRIPTIVE STATISTICS

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	Mean	1.495	1.495	0.231	0.231
2	Std Dev	2.084	5.936	0.322	0.916
3	Sum	163.000	163.000	25.154	25.154
4	Variance	4.342	35.241	0.103	0.839
5	SSQ	717.000	4085.000	17.075	97.284
6	MCSSQ	473.248	3841.248	11.270	91.479
7	Euc Norm	26.777	63.914	4.132	9.863
8	Minimum	0.000	0.000	0.000	0.000
9	Maximum	13.000	59.000	2.006	9.105

Network Centralization (Outdegree) = 1.792%
Network Centralization (Indegree) = 8.956%

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
MTS : The Directorate of Mining and Technical Search
Duzce CMC : Duzce Crisis Management Center
Bolu CMC : Bolu Crisis Management Center
Health M. : Health Ministry
Kizilay : Red Crescent
Istanbul P. : Istanbul Province
PMCMC : Prime Ministry Crisis Management Center
D.P.Safety : Duzce Public Safety

Source: *Cumhuriyet* news reports, November 12 - December 1, 1999 (Corbacioglu, 2004)

As indicated in Table 28, the degree centrality data for the Duzce operations show similar outcomes for the Marmara response operations (see Appendix F, Table 1 for degree centrality of all organizations). Provincial and local organizations have higher in-degree centrality while central organizations have higher out-degree centrality as it is in the Marmara response operations. Health Ministry (actor #33), Military (actor #16), and Kizilay (actor #54) were the most central organizations in terms of out-degree centrality. Duzce Crisis Management Center (actor #3), and Bolu Crisis Management Center (actor #2) were the most influential organizations in terms of in-degree centrality. According to the table, Prime Ministry Crisis Management Center (actor #1) that is the institution responsible for coordination of the response operations have weaker position in terms of centrality compared to the Marmara response. Since the Duzce earthquake was a local earthquake, provincial and local organizations were more active in responding to the disaster.

Table 27 and Table 28 also present descriptive analyses and network centralization of the two response network. According to these statistics, on the average, organizations have a degree of 2.41, and 1.495, respectively, for the Maramra and Duzce response network. The range of variability in degree is larger in the Marmara response network (26 vs 13), whereas the range of variability is larger in the Duzce response network (59 vs 49). This shows that some organizations played a substantive role during the Marmara earthquake in terms of initiating interactions (*e.g*. PMCMC), whereas some organizations took more central positions during the Duzce earthquake in terms of receiving interactions. In addition to these statistics, network centralization measures explore the degree of centralization in the networks. Freeman's graph centralization measure indicates that the Marmara response network has 3.59% in-degree, and 7.02% out-degree centrality, while the Duzce response network has 1.79% in-degree, and 8.96% out-degree centrality. Although network centralization statistics do not show highly centralized response systems, these data support the claim that the Marmara response network is more concentrated in terms of in-degree centrality, whereas the Duzce response system is more centralized in terms of out-degree centrality.

6.4.1.2 Closessness Centrality

Degree centrality measures only an actor's immediate ties. One actor could have more direct ties with others, so that the actor could be one of the most central actors in the network. However, if the other actors are disconnected from the network, the actor's position can be defined by its local ties.

Table 29 Closessness Centrality for the Marmara Response System

Actor#		Farness	nCloseness
1	PMCMC	1982.000	8.325
13	KOCMC	1988.000	8.300
7	Kizilay	2002.000	8.242
11	SACMC	2006.000	8.225
5	Military	2016.000	8.185
14	YACMC	2020.000	8.168
9	BOCMC	2023.000	8.156
2	PWSM	2032.000	8.120
36	BOTAS	2042.000	8.080
3	Interior M.	2051.000	8.045

Descriptive Statistics

		Farness	nCloseness
1	Mean	3098.321	7.359
2	Std Dev	4732.671	1.366
3	Sum	501928.000	1192.078
4	Variance	22398176.000	1.865
5	SSQ	5183638528.000	9074.090
6	MCSSQ	3628504576.000	302.179
7	Euc Norm	71997.492	95.258
8	Minimum	1982.000	0.606
9	Maximum	27225.000	8.325

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
KOCMC: Kocaeli Crisis Management Center
SACMC: Sakarya Crisis Management Center
YACMC: Yalova Crisis Management Center
PMCM : Prime Ministry Crisis Management Center
BOCMC: Bolu Crisis Management Center
ISCMC: Istanbul Crisis Management Center
National Education M.: National Education Ministry
Regional CMC: Regional Crisis Management Center
Health M. : Health Ministry
Interior M : Interior Ministry

Sources: *Cumhuriyet* news reports, August 17 - September 7, 1999 (Corbacioglu, 2004)

Closeness centrality can avoid this deficiency. Closeness centrality measures the distance of an organization to all other organizations in the network by focusing on the shortest distance from each organization to all others. According to the Marmara response closessness centrality data, the Prime Ministry Crisis Management Center (actor #1) is the most central organization in terms of closessness centrality (see Appendix E, Table 2). Kocaeli Crisis Management Center (actor #13), Kizilay (actor #7), Sakarya Crisis Management Center (actor #11), and Military (actor #5) follow the PMCMC. Health Ministry (actor #4), National Educational Ministry (actor #83), Interior Ministry (actor #3) lost their central positions relative to degree centrality measurements.

Table 30 Closessness Centrality for the Duzce Response System

Actor#		Farness	nCloseness
3	Duzce CMC	1584.000	6.818
16	Military	1630.000	6.626
33	Health M.	1635.000	6.606
54	Kizilay	1636.000	6.601
38	Istanbul P.	1649.000	6.549
37	Istanbul G.C. Mu.	1650.000	6.545
60	Prime Ministry	1651.000	6.541
8	Ankara G.C. Mu	1655.000	6.526
22	D. Civil D.	1655.000	6.526
65	SUBA	1655.000	6.526

Descriptive Statistics

		Farness	nCloseness
1	Mean	2840.661	5.666
2	Std Dev	3059.317	1.740
3	Sum	309632.000	617.586
4	Variance	9359420.000	3.029
5	SSQ	1899736192.000	3829.345
6	MCSSQ	1020176768.000	330.149
7	Euc Norm	43585.965	61.882
8	Minimum	1584.000	0.926
9	Maximum	11664.000	6.818

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
Duzce CMC : Duzce Crisis Management Center
Bolu CMC : Bolu Crisis Management Center
Health M. : Health Ministry
Kizilay : Red Crescent
Istanbul P. : Istanbul Province
PMCMC : Prime Ministry Crisis Management Center
Istanbul G.C. Mu. : Istanbul Greater Municipality
Ankara G.C. Mu. : Ankara Greater Municipality
D.Civil D. : Duzce Civil Defense

Source: *Cumhuriyet* news reports, November 12 - December 1, 1999 (Corbacioglu, 2004)

The data indicate that the Duzce Crisis Management Center remains the most central organization in the Duzce response network (see Appendix F, Table 2 for closessness centrality of all organizations). Similar to the results obtained for the degree centrality measurement, Military (actor #16), Health Ministry (actor #33), and Kizilay (actor #54) follow Duzce Crisis Management Center. Although, they have very low degree centrality measurements, Istanbul

Province Government (actor #38) and Istanbul Greater Municipality (actor #37) are in fifth and sixth place, respectively, in terms of closeness centrality. Compared with its degree centrality value, Bolu Crisis Management Center has a lower degree of closessness centrality.

6.4.1.3 Betweenness Centrality

Betweenness centrality provides information to assess an organization's positional advantage based upon whether it falls on the shortest pathway between other pairs of organizations.

According to betweenness centrality data in Table 31, the Prime Ministry Crisis Management Center (actor #1) is the most central organization which falls on the shortest pathway between other pairs of actors while it was the fourth most central organization in terms of degree centrality. Kocaeli Crisis Management Center (actor #13), Kizilay (actor #7), Military (actor # 5), Bolu Crisis Management Center (actor # 9), Yalova Crisis Management Center (actor #14), and Sakarya Crisis Management Center (actor # 11) are the other central organizations with the highest degree of betweenness centrality(see Appendix E, Table 3 for betweenness centrality of all organizations).

Table 32 shows betweenness centrality data for the Duzce response system. Military (actor #16) is the most central actor in the network. Bolu Crisis Management Center (actor #2), and the Prime Ministry Crisis Management Center (actor #1) are the second and the third most central organizations, respectively, followed by Istanbul Greater City Municipality (actor #37) and Istanbul Province (actor #38) (see Appendix F, Table 3 for betweenness centrality of all organizations).

The betweenness centrality statistics show that there is more variation in the Marmara response network (from 0 to 2552.16) than the Duzce response network (from 0 to 255.17). The overall network centralization is higher (9.24%) in the Marmara response network than in the

Duzce response network (1.90%). Although these data indicate that the Marmara response system had more intermediary actors (e.g. PMCMC, KOCMC), the response systems needed more agents that provide connections among disaster organizations

Table 31 Betweenness Centrality for the Marmara Response System

Actor#		Betweenness	nBetweenness
1	PMCMC	2552.156	9.431
13	KOCMC	1922.243	7.104
7	Kizilay	804.001	2.971
5	Military	762.387	2.817
9	BOCMC	762.234	2.817
14	YACMC	730.218	2.699
11	SACMC	610.451	2.256
50	Environment M.	447.167	1.653
2	PWSM	317.500	1.173
3	Interior M.	285.000	1.053

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		Betweenness	nBetweenness
1	Mean	68.108	0.252
2	Std Dev	278.363	1.029
3	Sum	11306.000	41.781
4	Variance	77485.914	1.058
5	SSQ	13632696.000	186.177
6	MCSSQ	12862662.000	175.661
7	Euc Norm	3692.248	13.645
8	Minimum	0.000	0.000
9	Maximum	2552.156	9.431

Network Centralization Index = 9.24%

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
KOCMC: Kocaeli Crisis Management Center
SACMC: Sakarya Crisis Management Center
YACMC: Yalova Crisis Management Center
PMCM : Prime Ministry Crisis Management Center
BOCMC: Bolu Crisis Management Center
ISCMC: Istanbul Crisis Management Center
National Education M.: National Education Ministry
Regional CMC: Regional Crisis Management Center
Health M. : Health Ministry
Environment M. : Environment Ministry

Sources: *Cumhuriyet* news reports, August 17 - September 7, 1999 (Corbacioglu, 2004)

Table 32 Betweenness Centrality for the Duzce Response System

Actor#		Betweenness	nBetweenness
16	Military	225.167	1.948
2	Bolu CMC	171.833	1.487
1	PMCMC	157.167	1.360
37	Istanbul G.C. Mu.	88.833	0.769
38	Istanbul P.	82.000	0.710
60	Prime Ministry	33.000	0.286
23	D. Highways	18.000	0.156
54	Kizilay	15.000	0.130
74	TNA	3.000	0.026
58	President Demirel	3.000	0.026
DESCRIPTIVE STATISTICS FOR EACH MEASURE			
		Betweenness	nBetweenness
1	Mean	7.376	0.064
2	Std Dev	32.521	0.281
3	Sum	804.000	6.957
4	Variance	1057.615	0.079
5	SSQ	121210.445	9.077
6	MCSSQ	115280.023	8.633
7	Euc Norm	348.153	3.013
8	Minimum	0.000	0.000
9	Maximum	225.167	1.948
Network Centralization Index = 1.90%			

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
Bolu CMC : Bolu Crisis Management Center
PMCMC : Prime Ministry Crisis Management Center
D.Highways : General Directorate of Highways
Kizilay : Red Crescent
Istanbul G.C.Mu: Istanbul Greater City Municipality
Istanbul P. Istanbul Province Government
TNA: Turkish National Assembly

Source: *Cumhuriyet* news reports, November 12 - December 1, 1999 (Corbacioglu, 2004)

6.4.1.4 Flow Betweenness Centrality

Flow Betweenness centrality measures not only the shortest pathways between two pairs of organizations but also all other alternative pathways by which an organization can use to reach the others.

The flow betweenness centrality data produce similar results to the betweenness centrality data. As revealed in Table 33, the crisis management centers are the most influential actors in the Marmara response operations. According to the table, the Prime Ministry Crisis

Management Center (PMCMC), (actor #1) is the most central actor followed by Kocaeli Crisis Management Center (CMC), (actor#13), Yalova Crisis Management Center (CMC), (actor #14), and Bolu Crisis Management Center (CMC), (actor #9). Interior Ministry (actor r#3), Kizilay (actor #7), Environment Ministry (actor #50), and Military (actor #7) are the other organizations that exhibit high degree of flow betweenness centrality (see Appendix E, Table 4 for flow betweenness centrality of all organizations).

The outcomes of flow betweenness centrality for the Duzce response system are parallel to the outcomes of Duzce betweenness centrality. Although the Prime Ministry Crisis Management Center (PMCMC), (actor #1) and Military (actor #16) reversed their positions, the five most influential organizations remained the same. Following the PMCMC and Military, the first and the second respectively, Bolu Crisis Management Center (actor #2), Istanbul Greater City Municipality (actor # 37), and Istanbul Province Government (actor # 38) are the most central organizations in the network in terms of flow betweenness centrality. Duzce Crisis Management Center is the most central actor according to the degree and closessness centrality; however, it does not display a high degree of betweenness and flow betweenness centrality (see Appendix F, Table 4 for flow betweenness centrality of all organizations).

The descriptive statistics of both response networks reveal similar findings that flow betweenness centrality data explored. The variation in the Marmara response network is substantially higher (4303.36) than in the Duzce response network (258). Likewise, network centralization is higher (15.69%) in the Marmara response network than in the Duzce network (2.19%). The network centralization data of flow betweenness centrality are higher than betweenness centrality that was based on shortest pathway. The findings strengthen the central positions of Prime Ministry Crisis Management Center, Kocaeli, Bolu, and Yalova Crisis

Management Centers. Coordination of response operations would be significantly worse if these organizations did not create connections among disaster organizations.

Table 33 Flow Betweenness Centrality for the Marmara Response System

Actor#		FlowBet	nFlowBet
1	PMCMC	4303.363	15.903
13	KOCMC	1440.825	5.325
14	YACMC	1275.794	4.715
9	BOCMC	1192.773	4.408
3	Interior M.	663.691	2.453
7	Kizilay	660.041	2.439
50	Environment M.	517.727	1.913
5	Military	507.704	1.876
71	KOCI	377.136	1.394
11	SACMC	301.230	1.113
Network Centralization Index = 15.691%			
Descriptive Statistics for Each Meausre			
1	Mean	82.857	0.306
2	Std Dev	384.770	1.422
3	Sum	13754.238	50.829
4	Variance	148048.328	2.022
5	SSQ	25715656.000	351.190
6	MCSSQ	24576022.000	335.626
7	Euc Norm	5071.061	18.740
8	Minimum	0.000	0.000
9	Maximum	4303.363	15.903

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
KoCMC : Kocaeli Crisis Management Center
SaCMC : Sakarya Crisis Management Center
YACMC : Yalova Crisis Management Center
PMCM :Prime Ministry Crisis Management Center
BOCMC : Bolu Crisis Management Center
Kizilay : Red Crescent
Environment M. Environment Ministry
Interior M. : Interior Ministry
KOCI: Kocaeli Chamber of Industry

Sources: *Cumhuriyet* news reports, August 17 - September 7, 1999 (Corbacioglu, 2004)

In both cases, the Marmara and Duzce, provincial and local crisis management center acted as primary actors for coordinating the response and recovery operations. The Prime Ministry Crisis Management Center, officially responsible for overall coordination of response operations, is identified as the most central organization in both response systems. According to the centrality analyses' results, Kizilay and Military were also very active organizations during the response operations. The centrality measures indicate the practical circumstances which would be beneficial for restructuring organizational and technical aspects of the Turkish disaster system.

Table 34 Flow Betweenness Centrality for the Duzce Response System

Actor#		FlowBet	nFlowBet
1	PMCMC	258.000	2.233
16	Military	251.000	2.172
2	Bolu CMC	172.833	1.496
37	Istanbul G.C. Mu.	66.667	0.577
38	Istanbul P.	56.000	0.485
60	Prime Ministry	26.000	0.225
23	D. Highways	13.000	0.112
Network Centralization Index = 2.186%			
DESCRIPTIVE STATISTICS FOR EACH MEASURE			
		FlowBet	nFlowBet
1	Mean	7.739	0.067
2	Std Dev	38.472	0.333
3	Sum	843.500	7.299
4	Variance	1480.132	0.111
5	SSQ	167861.797	12.570
6	MCSSQ	161334.359	12.081
7	Euc Norm	409.709	3.545
8	Minimum	0.000	0.000
9	Maximum	258.000	2.233

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
PMCMC : Prime Ministry Crisis Management Center
Bolu CMC : Bolu Crisis Management Center
Istanbul P. : Istanbul Province
D.Highways : General Directorate of Highways
Istanbul G.C.Mu: Istanbul Greater City Municipality
BOCMC : Bolu Crisis Management Center

Source: *Cumhuriyet* news reports, November 12 - December 1, 1999 (Corbacioglu, 2004)

6.4.2 Cliques

Table 5 (see Appendix E) provides information about the cliques (subgroups) identified in the 1999 Marmara and Duzce response operations. There are 80 cliques for the Marmara response operations (see Appendix E, Table 5). The largest clique is composed of four actors. According to the data, crisis management centers are the most active actors that interact with others in subgroups. Sakarya CMC (actor #11) has the highest participation in cliques as a member of 40 existing cliques. The total number of clique membership is 27 for Kocaeli (CMC) (actor #13), 24 for (PMCMC) (actor #1), 21 for Bolu (CMC) (actor #9), and 9 for Yalova (CMC) (actor #14). Consistent with centrality data, Military, Kizilay and Interior Ministry are the other actors that are the members of several cliques.

Based upon the data, there are 18 cliques for the Duzce response operations (Appendix F, Table 5). The largest clique consists of 4 actors. Duzce (CMC) is the most active actor with 12 clique memberships. The highest number following Duzce (CMC) is Military (actor #16) with 6 clique memberships. Bolu (CMC) (actor # 2) and Istanbul Province (actor # 38) have 5 clique memberships apiece, and Kizilay (actor # 54), 4 such memberships.

6.5 COMMUNICATION CREATES DIFFERENCES

The analyses revealed the strengths and weaknesses of the Turkish disaster response system. Statistical analysis of Emergency Support Function in conjunction with the UCINET analysis (Borgatti, Everett, Freeman 2002) showed that the 1999 Marmara and Duzce disaster response systems were mainly operated by public-central organizations with considerable assistance from public-international and public provincial organizations. The inadequate involvement of public-district and public-municipal organizations hindered the performance of the response systems in terms of coordinated response operations, especially during the Marmara earthquake. Statistical analysis of ESFs proved that inadequate communication and information capacity of the system restrained coordination of response operations thus restrained coordinated search and rescue operations. This situation created a public disapproval of Turkish public administration's performance in the Marmara earthquake.

After this disappointing performance, the system was more prepared and performed better during the Duzce response operations. The ESFs and transaction analyses indicated that increasing communication functions improved coordination of response operations, thus enhanced the performance of the system in search and rescue operations. Increases in information flow among organizations facilitated more involvement of local organizations which was very decisive for the effective response system during the Duzce earthquake.

According to centrality measures, crisis management centers were very active and central actors during the 1999 earthquake response operations. The Prime Ministry Crisis Management Center was the most central agency in both response systems. Provincial crisis management centers were very active during the Duzce earthquake. These centers coordinated response activities. Due to the success of these centers, every city in the region established a permanent crisis management center after the earthquakes. Each center was equipped with necessary tools to manage and coordinate disaster affairs.

6.6 SUMMARY

This chapter reviewed the performance of the 1999 response systems that evolved following the Marmara and Duzce earthquakes. The types of organizations involved in response operations and the form of transactions made by these organizations were analyzed. I also reviewed the types of transactions among disaster organizations from different jurisdictions.

The analysis showed that public national and international organizations played very significant roles in the response operations. The public-central organizations are more central in both response systems. However, the Duzce response system involved relatively more local disaster agencies than the Marmara response system. The disaster response operations were more coordinated in the Duzce response system. The data showed that increased communication activities improved coordinated response operations during the Duzce earthquake.

Inferences from the analyses exposed some gaps in the Turkish disaster system. The system remains very centralized and bureaucratic in which district governments and municipalities do not play significant roles in the system. Moreover, nonprofit and private organizations do not appear to be important components of the system.

Seismic risk affects every aspect of community life. It requires a combination of efforts and expertise from various sources to address the challenges it poses. The disaster management system needs to unite these different sources for better performance, and in particular, to encourage more involvement of disaster organizations at the local level.

7.0 REFORMING THE TURKISH DISASTER MANAGEMENT SYSTEM

7.1 INTRODUCTION

Data collected from primary sources were analyzed to identify the organizations and the interactions involved in the projects initiated after the 1999 earthquakes in order to improve organizational and informational capacity of the Turkish disaster system. The analysis also includes the projects that were initiated prior to, but continued after, the 1999 Earthquakes. The data were collected from official websites of disaster organizations, interviews, content analyses of *Cumhuriyet Scientific and Technical Section* (May 1998-May 2005), and situation and professional reports. The research identifies transactions and interaction patterns among the organizations involved in investing the information and organizational infrastructure after the earthquakes. These data reveal characteristics of inter-organizational network in the projects.

After the complex problems of disaster operations during the 1999 earthquakes, the Turkish disaster system recognized the necessity of improving organizational and informational capacity to cope with future catastrophic disasters. Funded by national and international sources, many projects were initiated after the 1999 earthquakes. Individual disaster organizations, especially provincial governments, implemented various projects to improve the response capacity of their own organizations. However, this chapter only analyzes joint projects that are carried out by two or more organizations and does not include individual organizational attempts.

These projects are relatively small activities and have been initiated by an individual organization without cooperation with others. These activities are mainly focused on improving the response capacity of the system, increasing personnel capacity of rescue teams, training activities, and reorganizing and developing technical equipment (*e.g.* buying a new fire truck). The next chapter will analyze these developments.

In the first part of the chapter, I present the frequency distribution of the organizations that were involved in the projects. Then, I classify and analyze the projects based on their primary purposes. Finally, I use social network analysis to identify the role of organizations participating in the projects, and the interactions among them. The UCINET 6.0 software program (Borgatti, Everett, Freeman, 2002) was used to analyze centrality measurements to identify the most dynamic organizations and interaction patterns in the network. In this chapter, I explore to what extent the efforts undertaken after the earthquakes are sufficient to close the gaps in the Turkish disaster system.

7.2 TYPES OF ORGANIZATIONS CONTRIBUTING TO DISASTER MANAGEMENT PROJECTS

The research identified the primary organizations involved in the projects. As shown in Table 35, there are 154 organizations involved in the projects (see Appendix H for the list of organizations). Eighty-five of 154 (55.19%) organizations are national public, nonprofit and private while 69 of 154 (44.81%) organizations involved in the project are international. Most of the organizations involved in the projects are public. From Table 23, we can observe that 34 of the 69 (48.57%) international organizations and 71 of 85 (83.53%) national organizations are public. Also significant is the role of domestic public-central organizations (26.32%). International public (22.08%), international nonprofit (16.23%), and domestic public-province organizations (12.99%) have had notable roles in the projects as well.

Domestic and international research institutions understandably play significant roles in redesigning the Turkish disaster system. Sixty-one of 154 (39.61%) organizations are research institutions of which 20, or 32.78%, are domestic central organizations. Although most national research institutions (*e.g.* universities) operate at the province level, and mainly cooperate with province administrations, they are legally considered to be public-central organizations.

Table 35 Types of Organizations Contributed in Disaster Management Projects Reported by Primary Funding Source Jurisdictions

National Organizations	**N**	**%**	**N of Research Institutions**
Public-Central	40	26.32	20 of 40 are research institutions, 50%
Public-Province	20	12.99	
Public-District	2	1.30	
Public-Municipal	9	5.84	
Nonprofit	7	4.55	
Private	7	4.55	
Total National	**85**	**55.19**	
International Organizations	**N**	**%**	**N % of Research Institutions**
International-Public	34	22.08	25 of 34 are research institutions, 73.52%
International-Nonprofit	25	16.23	16 of 25 are research institutions,64.0%
International-Private	10	6.49	
Total International	**69**	**44.81**	
Total Organizations	**154**	**100.00**	

N=Number of Organizations; %=Percentage of Organizations
Source: Appendix C

International organizations consist of more research institutions than do national organizations. Forty one of 61 (67.21%) research institutions are international. All national research institutions and most international ones are public. Twenty of 71 (28.17%) domestic public organizations, 25 of 34 (73.52%) international public organizations, and 16 of 25 (64%) international nonprofit, are research institutions.

Table 36 National Organizations Contributed in Disaster Management Projects Reported by Primary Funding Source & Jurisdictions

National Organizations	**N**	**%**
Public-central	40	47.06
Public-province	20	23.53
Public-district	2	2.35
Public-municipal	9	10.59
Nonprofit	7	8.24
Private	7	8.24
Total	**85**	**100.00**

N=Number of Organizations; %=Percentage of Organizations
Source: Appendix C

According to Table 36, most national organizations are public-central organizations. Thirty nine of 85 (47.06%) are public-central organizations, whereas 20 of 85 (23.53%) are public-province organizations. There are nine (10.59%) municipalities, including 3 district municipalities that participated in the projects. Only two of 85 (2.35%) national organizations are public-district. Equal numbers of national nonprofit and private organizations (7; 8.24%) are involved in the projects.

Table 37 International Organizations Contributed in Disaster Management Projects Reported by Primary Funding Source & Jurisdictions

International	**N**	**%**
International Public	34	49.28
International Nonprofit	25	36.23
International Private	10	14.49
Total	**69**	**100.00**

N=Number of Organizations; %=Percentage of Organizations
Source: Appendix C

As depicted in Table 37, most international organizations contributing to the projects are public organizations. Thirty-four of 69 (49.28%) international organizations are public whereas 25 of 69 (36.23%) are nonprofit. In addition, ten international private organizations (14.49%) are involved in the projects.

More international nonprofit and private organizations are involved in the projects than national nonprofit and private organizations. Only 14 of the 85 (16.48%) national organizations are private and nonprofit whereas slightly more than half of the international organizations, 35 of 69 (50.72%) are private and nonprofit.

7.3 THE GOAL OF THE PROJECTS

The research identified 93 primary shared projects that are aimed at establishing and developing organizational and informational infrastructure of the system (see Appendix I for a detailed list of joint projects). Some, but not all, of these projects are completed. I categorize the projects based on type of actions (*e.g.* the subject/purpose of the project) to determine the main goal of Turkish disaster management.

The main goal of these projects is to increase the capacity of disaster system for different cycles of the disaster management: mitigation, preparedness, response, and recovery. Mitigation and preparedness are the stages in which responsible disaster managers design and develop policies and structures to diminish the catastrophic effects of disasters before they occur. At these phases, organizations also prepare strategic plans to clarify the tasks that have to be executed by different organizations during the four phases of disasters. The performance of a disaster management system in responding to a disaster depends on actions that are taken during the mitigation and preparedness stages.

Response and recovery phases come after a disaster occurs and test the capacity and awareness of the system to a disaster. Responsible managers of disaster systems may invest more in mitigation and preparedness activities in order to be successful in response and recovery stages.

7.3.1 Earthquake Monitoring and Recording

After the 1999 disasters, the Turkish disaster management system developed considerably its capacity to monitor and record seismic activity across the country. The primary organizations that initiated projects for continuous earthquake monitoring and recording activities include the Turkish Scientific and Technical Council and Marmara Research Center (TUBITAK-MAM), Earthquake Research Department under the General Directorate of Disaster Affairs, Bogazici University Kandilli Observatory and Earthquake Engineering (Bogazici-KOERI), Istanbul Metropolitan Municipality, General Command of Mapping.

Thirty-eight digital accelerometers were added to Strong Ground Motion Network, and 14 earthquake monitoring and recording stations were established by Bogazici University and Istanbul Metropolitan Municipality to monitor seismic event occurring along the North Anatolian Fault Line. TUBITAK initiated several projects for the same purposes. Twenty-two earthquake recording stations were built to monitor changes and movements in the West, Central and Southern Anatolian fault lines and several more stations are planned. TUBITAK Marmara Research Center, a leader in conducting seismological, geodetic and geological studies, erected one soil gas radon observation station on the East Anatolian fault line to monitor radon gas activities for future earthquake risk. General Command of Mapping joined a project to establish 16 earthquake stations throughout Turkey for monitoring purposes. The ultimate goal is to complete 50 stations. Finally, the Earthquake Research Department initiated two main projects between 2002 and 2003: 20 modern acceleration recording instruments around two arrays

(Yalova-Bursa and Aydin-Denizli) and 18 modern acceleration recording instruments around the array (Antakya-Maras) were positioned for monitoring and recording underground movements.

These studies improved the monitoring and recording capacity of the Turkish disaster system compared to the pre-earthquake period.[31] Disaster organizations such as Earthquake Research Department and Kandilli Observatory continuously analyze and record seismic activities twenty-four hours across the country.

7.3.2 Geodesic and Geophysics

After the 1999 earthquakes, research institutions conducted many joint and individual projects to investigate geodesic and geophysical characteristics of fault lines, especially the North Anatolian Fault Line. Bogazici-KOERI, Istanbul Technical University, and TUBITAK-MAM initiated important projects to investigate deformation and movements in the fault line after the earthquakes. They include Monitoring Crustal Deformation by Different Geodetic Measurement Techniques, Determining Current Tectonic Features of Central Part of NAF by GPS Measurements, Crustal Deformation and Block Kinematics the Eastern Sector of the NAF by GPS Measurements, and Investigations on the Fault Line in the North Shore of Marmara Sea by using Electric and Electromagnetic instruments. TUBITAK-MAM and Yildiz technical University began researches to determine the deformation in the region after the Marmara earthquake. These investigations are very vital to assess the changes in seismic risk prone areas and provide information for responsible policy makers to minimize the impact of a major earthquake on a community's life.

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[31] Interview with General Directorate of Disaster Affairs, Earthquake Research Center, June 10, 2004

Seismological investigations are also conducted in the Marmara Sea. Scientists from France and Turkey conducted a project, “French-Turk SEISMARMARA Joint Project in the Marmara Sea” to collect seismological data in order to assess seismic risk in the Marmara Sea. The data were also analyzed to evaluate the risk of a Tsunami during a possible future earthquake in the Marmara Sea.

One important project is the “Marmara Earthquake Recovery Land Identification System (MERLIS)”. The project has developed as part of the Marmara Earthquake Emergency Recovery (MEER) that the Prime Ministry Implementation Unit initiated in 1999. The MERLIS project has been carried out by the General Directorate of Land Registry and Cadastre (GDLRC). The GDLRC has been renewing cadastral information and creating a land registry and cadastral database system which will be based for construction activities for the Marmara region.

The MERLIS and MEER are considered two important projects for urban development policies. After the completion of these projects, local organizations (*e.g.* municipalities) will have an updated cadastral database that is prepared based on seismic codes, and will utilize to regulate construction activities in the Marmara region. However, experiences showed that a strong political and legal will should be behind these regulations for them to be effective.[32]

> “…Governments should enforce this rule. Otherwise these changes do not make any differences. For instance, we did a pilot study in Zeytinburnu[33] and completed geodesic and geophysical analyses. We decided that we have to renew the entire neighborhood and move people to somewhere else. We can find financial assistance to do this. But, it becomes a purely political and legal decision because it is hard to persuade people to move…”

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[32] Interview with Directorate of Earthquake Department, Istanbul Metropolitan Municipality, June 22, 2004

[33] Zeytinburnu is a neighborhood under a high seismic risk in European part of Istanbul.

7.3.3 Earthquake Prediction and Early Warning

Bogazici University Kandilli Observatory and Earthquake Engineering (Bogazici-KOERI), Turkish Scientific and Technical Council and Marmara Research Center (TUBITAK-MAM), Istanbul Technical University, and Turkish Red Crescent Society Emergency Coordination Center (Kizilay-AFOM) are the primary organizations that initiated projects for the purpose of earthquake prediction.

The most comprehensive earthquake prediction project developed under the supervision of Bogazici-KOERI with financial and technical assistances from Istanbul Province Government, The First Army Headquarter, Istanbul Metropolitan Municipality, and GeoSig & Electrowatt Ekono Consortium is the "Istanbul Earthquake Rapid Response and Early Warning Project". For this early warning system, 110 stations were established to monitor seismic activities. Istanbul Technical University also ran a similar project between 2000 and 2004. Thirty stations were built to observe geological rock stress and thus predict earthquakes.

TUBITAK-MAM led two research projects in 2003 and 2004 to investigate the relationship between soil, radon gas, spring water, and earthquake predict future damaging earthquakes. Istanbul Metropolitan Municipality supported a study, "Testing New Methods for the Prediction of Earthquakes in the Marmara Region" to investigate anomalies in spring water, soil, and radon gas and compare the results with GPS studies and seismological data to determine the relations between such anomalies and seismic activity. Finally, Kizilay-AFOM planned to establish a satellite early warning system for rapid response.

Earthquake prediction and early warning studies aim to improve the capacity of the system for later stages of disaster management. These studies aim to prevent possible post-earthquake disaster such as fire and chemical explosions. Although these projects are important to diminish the destructive consequences of an earthquake, they do not increase sustainability of local communities to seismic risk.

7.3.4 Emergency Response and Recovery

Istanbul Province Government, Prime Ministry Project Implementation Unit, Bogazici University Center for Disaster Management, TUBITAK-MAM, Yildiz Technical University, and General Directorate of Civil Defense are the primary organizations that initiated essential projects for emergency response and recovery purposes.

The most important development discussed in this chapter to strengthen the emergency response capacity of the system was the formation of 11 regional professional rescue teams by the General Directorate of Civil Defense. Istanbul Province Government established disaster stations with necessary equipment in 32 district centers for immediate need for rescue operations.

Prime Ministry Project Implementation Unit (PIU) supported several important projects that aimed to increase response capacity of the system as well as recovery and rehabilitation from the 1999 earthquakes. PIU initiated two projects between 2000 and 2004, Marmara Earthquake Rehabilitation Program and Turkey Earthquake Rehabilitation and Reconstruction Assistant Project (TERRA), which provided different reconstruction and psycho-social rehabilitation activities, and assistance to municipalities for implementation of their disaster recovery and reconstruction plans. Another project that PIU supported is Turkey Earthquake and Flood Emergency Recovery Project (TEFER) which focuses on recovering from the damages of future destructive disasters and developing hazard mitigation strategies. Prime Ministry Project Implementation Unit also supported Marmara Earthquake and Recovery Project (MEER) from

1999 to 2005, which established the Establishing Turkish Emergency Management Agency and institutionalized the Mandatory Insurance Program.

The elites in The Turkish disaster management acknowledged that the capacity of the disaster system increased significantly for rescue and recovery phases[34]. Official rescue groups in combination with volunteer rescue teams created a better responsive disaster system. Responsible managers believe that Turkey has one of the finest response systems in terms of search and rescue operations[35].

> "…After difficulties in search and rescue operations in the 1999 earthquakes, we focused on this issue. We established very professional rescue groups. For instance, they performed effectively in Iran earthquake. Now we send them to many earthquakes in different countries and we get very good appraisal from their governments…"

7.3.5 Information Management

During the 1999 disaster response operations, lack of valid geographic information for disaster prone areas significantly hampered the ability of disaster organizations to assist needy communities. After the earthquakes, municipalities and provincial governments in the region initiated projects to create a Geographic Information Systems (GIS) for disaster management purposes. Istanbul Province Government, Bursa Municipality, Bolu Government, Sakarya Government, Istanbul Metropolitan Municipality and Duzce Municipality established a GIS urban knowledge base for public affairs that included disaster affairs and land development

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[34] Interview with Duzce Province Government, June 14, 2004
Interview with Yalova Crisis Management Center, June 17, 2004
Interview with Sakarya Civil Defense Rescue Group, June 15, 2004
[35] Interview with General Directorate of Civil Defense, June 8, 2004

affairs. Also, TUBITAK-MAM conducted a project to create a GIS database for Yalova for the purposes of land development management and disaster affairs.

Istanbul Technical University Disaster Management Center undertook a project called "The Development of National Database Using GIS & Remote Sensing Systems and the Standards for a Disaster Management System" to form a GIS base for a nationwide disaster information management system. TUBITAK also conducted a joint project, Seismological Network Calibration between Israel and Turkey, with organizations from Israel to establish a database about micro-earthquake activities, and seismio-tectonic data of the East Mediterranean Sea. Istanbul Metropolitan Municipality initiated a comprehensive project in 2001 to collect borehole data about the Istanbul Metropolitan area in order to establish a digital database. This database will be used for land development policies that will regulate construction activities in the metropolitan area of Istanbul.

Bogazici University Disaster Management Center (BU-CENDIM) conducted several joint projects for both preparedness and recovery purposes. One of them, "Istanbul Disaster Preparedness Education Project", was carried out between 2001 and 2003. Increasing emergency awareness, developing a GIS project to integrate disaster capability with USGS, and creating a web-site for information sharing were the main goals in this project. BU-CENDIM also carried out projects that aimed to establish a disaster management decision support system. "Authority and Communication Systems for Disaster Management: An Integrated Model" was initiated to develop an authority and communication structure for policy formulation, decision making and coordination for disaster preparation and response operations for Istanbul. "Integrated Decision Support System for Disaster Management in Turkey" was conducted by BU-Cendim to enhance the emergency recovery and humanitarian relief capability of the disaster system by focusing on preparedness and response strategies for potential major earthquakes in Istanbul.

Inadequacies in information process capacity of the disaster system awakened the Turkish disaster organizations and they invested more in information systems compared to before the 1999 earthquakes. These developments are in the early stages of adopting information systems in most organizations. Especially, local disaster organizations lack financial, technical and personnel capacity to adopt these systems and they rely primarily on outside assistance.[36] The analysis also shows that the lack of well-developed knowledge base among disaster organizations remains an important challenge.

7.3.6 Communication and Coordination

Disaster organizations completed many individual projects to establish communication channels among themselves. Obtaining satellite phones, wireless communication systems, and creating websites are some of the activities that individual disaster organizations executed by using their own sources. Moreover, several joint projects were carried out to establish secure communication channels among disaster organizations. TUBITAK initiated an important project, "BILSAT" which is the first Turkish observation satellite launched in 2003. The main function of the satellite is disaster monitoring and communication. BILSAT is considered to take part in "The Disaster Monitoring Constellation (DMC) Consortium", which consists of the satellites of Algeria, China, Nigeria, Thailand, and the United Kingdom.

[36]Interview with Golcuk Crisis Management Center, June 16, 2004

One key development was the formation of a wireless communication network among provincial disaster management centers in the Marmara region. Turkish Amateur Radio Club (TRAC) opened permanent stations in disaster management centers in Sakarya, Bursa, Yalova, Kocaeli, and Istanbul. TRAC also signed an agreement in 2000 with the General Directorate of Turkey Emergency Management, General Directorate of Civil Defense, and International Federation of the Red Cross for emergency communication. TRAC and participating organizations agreed on logistic and technical support, information sharing and increasing human resources in order to supply better communication for disaster affairs.

Istanbul Provincial Government initiated an information network project to create a communication network among district disaster management centers in Istanbul and Istanbul Province Crisis Management Center. This communication network is assumed to increase information exchange among district crisis management centers. Therefore, responsible managers are able to share sources to perform necessary technical and organizational changes and implement appropriate policies to improve the capacity of the emergency management system.

After the establishment of the General Directorate of Turkey Emergency Management Agency (see chapter 4 for detailed explanation), the most important development in coordination of disaster affairs was the establishment of permanent crisis management centers under province and district governments. Before the 1999 earthquakes, these centers were only active during the emergency response and recovery phases. However, after the earthquakes, every province and district government placed emphasis upon the creation of permanent crisis management centers so that disaster affairs can be managed and coordinated from preparedness to recovery phases.

The Turkish Red Crescent Society (Kizilay) established a sub-organization (Kizilay-AFOM) in Ankara to coordinate and manage outside assistance during response operations. This center is also responsible for managing inventories in order to avoid any shortage during a major disaster.

There are several points to be mentioned about communication and coordination activities. First, despite of these developments, coordination of disaster affairs is still an important issue that is to be addressed. The General Directorate of Turkey Emergency Management is not able to practically serve its duty.[37]The legal and technical foundation of the agency should be improved so that the agency could perform the tasks for coordination purposes.

Second, nonprofit organizations, TRAC, Kizilay-AFOM, played important roles in these attempts. However, improvements in communication channels do not provide a well-connection between central and local, especially district, organizations[38].

7.3.7 Risk Assessment and Earthquake Scenario and Planning

Bogazici KOERI, Istanbul Technical University, Istanbul Metropolitan Municipality, General Directorate of Disaster Affairs, Kizilay AFOM, Kocaeli University, Izmir Municipality carried out joint projects to assess seismic risk and develop earthquake scenarios and plans.

Seismic microzonation studies have been conducted in the Marmara region to assess seismic risk and develop appropriate policies for disaster mitigation. Istanbul Metropolitan Municipality started a project in 2000, "The Study on Disaster Prevention, Mitigation Basic Plan in Istanbul Including Seismic Microzonation in the Republic of Turkey" to create seismic

[37] Interview with General Directorate of Turkey Emergency Management, June 7, 2004
[38] Interview with Turkish Amateur Radio Club, June 23, 2004

microzonation maps and collect microzonation data to evaluate seismic risk in every neighborhood within the metropolitan area. Preparation of this database is very crucial for land development strategies.

Kocaeli University conducted the study, "Seismic Microzonation of Izmit and its Surroundings by GIS" in order to examine the impact of the Kocaeli earthquake and evaluate future seismic risks. The General Directorate of Disaster Affairs started a project in March 2002 and completed it in February 2004. With this, "Seismic Microzonation for Municipalities (microzonation for Earthquake Risk Mitigation, MERM)," GDDA aimed to create microzonation maps as applicable databases for administration of land development activities.

Two metropolitan municipalities that are exposed to significant seismic risk, Izmir and Istanbul, prepared a comprehensive earthquake master plan for their cities. Izmir metropolitan municipality completed its master plan, "An Earthquake Damage Scenario and Earthquake Master Plan for Izmir" at the end of 1999. This plan includes various damage assessment scenarios, alternative plans and strategies to cope with damage that a possible earthquake creates.

The master plan that Istanbul Metropolitan Municipality initiated and supported is the most comprehensive plan and includes every aspect of disaster affairs for Istanbul to prevent future losses from an expected Istanbul Earthquake. Disaster experts from Bogazici University, Istanbul Technical University, Yildiz Technical University, and Middle East Technical University worked two years (2002-2003) to prepare this master plan. It includes explanations of the legal, technical, and organizational bases of Turkish disaster management and proposes solutions to avoid possible destructive consequences of a future Istanbul earthquake.

In contrast to the limited capability of the disaster system before the 1999 earthquakes (Comfort, 2000), disaster organizations developed a considerable number of risk assessment models and prepared strategic plans. The Istanbul Master Plan is considered the best investigation and plan that could be conducted.[39] President of Bogazici Kandilli Observatory stated this fact as:

> "…The knowledgeable researchers from four universities worked two years to prepare this plan. We received financial and technical support from the Istanbul Metropolitan Municipality. From information management to legal process, we have studied every aspects of seismic risk in Istanbul and proposed policies to manage this risk. Now, we have to implement these policies before it is late…"

7.3.8 Education and Training Projects

Istanbul Technical University Center of Excellence for Disaster Management (ITU-CEDM) initiated studies for educating and training purposes. The center implemented a project between 2001 and 2003 in cooperation with Federal Emergency Management (FEMA-USA) and Turkish Interior Ministry. The National Emergency Management, Education and Exercise Implementation Program aimed to provide sustainability to the emergency management system of Turkey via the training. The center also run the project, A Cooperative Hazard Impact reduction Effort via Education (ACHIEVE) to train and educate responsible managers.

The ITU-CEDM carried out "Red Cross Education Project" with Kizilay and FEMA. The project had several purposes such as first aid training, community emergency response team training and GIS education for disaster management. In addition, the municipalities and crisis management centers in the region carried out many individual programs to train rescue teams and educate responsible managers for disaster response and recovery purposes. The disaster organizations implemented training and education programs not only for public professional

[39] Interview with Bogazici University Kandilli Observatory, June 24, 2004

rescue teams, but also volunteer groups to build rescue capacity in local communities. A program first implemented in Kocaeli to establish Neighborhood Volunteer Rescue Groups served as the model for other cities. These training and education programs significantly enhanced the quality and quantity of rescue capacity of the Turkish disaster system.

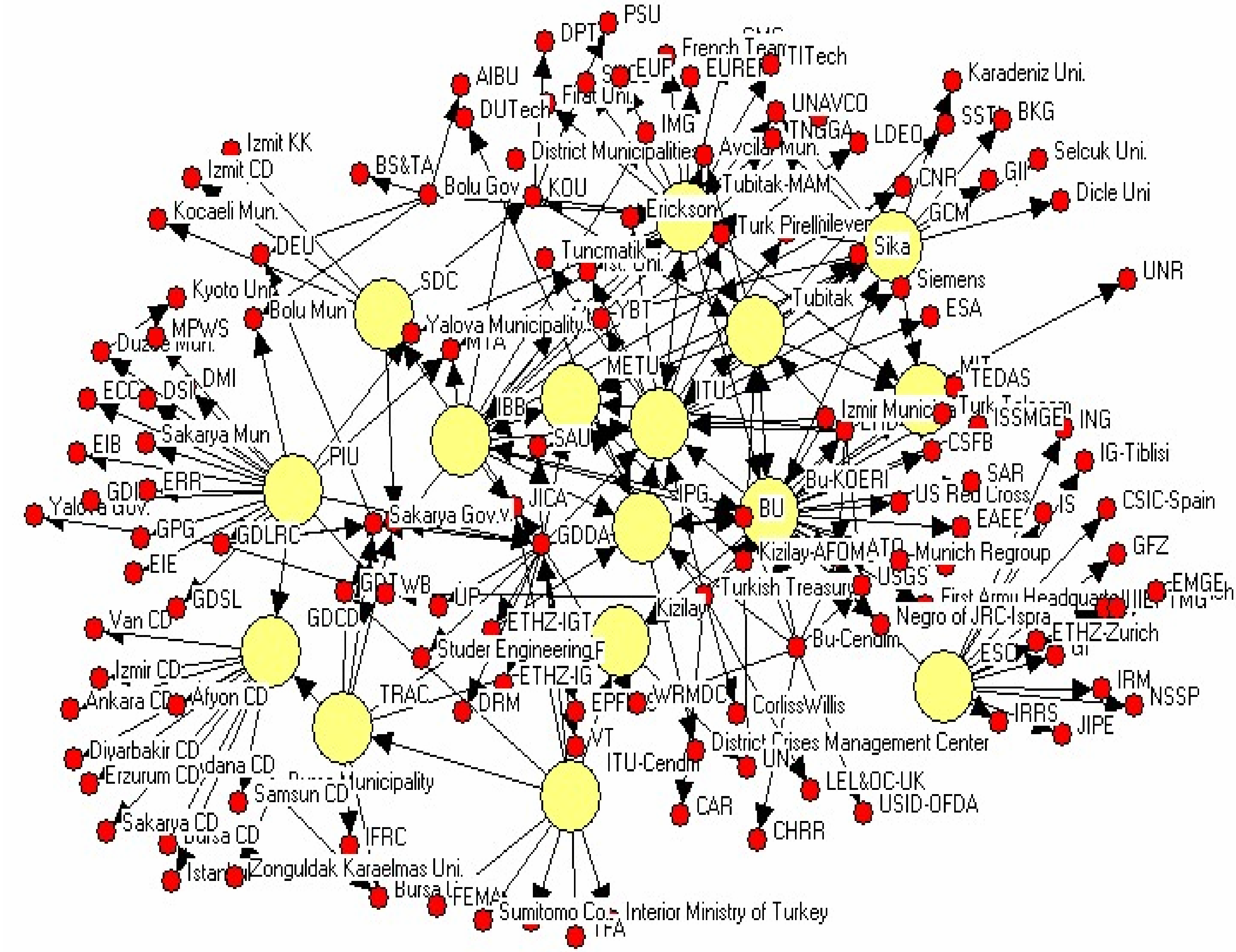
As summarized above, these education and training activities were mainly focused on rescue, recovery, and relief stages of disaster management cycles. The responsible managers point out this fact[40]:

> "…We have to teach the citizens and personnel that they have to face seismic risk and they have to learn how to live with that. What we are doing is to teach them how to survive after an earthquake happens. Of course this is important as well. This is a very complex issue. But the first thing that we have to teach and train ourselves is that this seismic risk was here, is here and will be here. So, we have to learn to change our attitudes to cope with this risk…"

7.4 INTER-ORGANIZATIONAL NETWORK IN EFFORTS UNDERTAKEN AFTER 1999 EARTHQUAKES

In this section of the study, I utilize the UCINET 6.0 (Borgatti, Everett, Freeman, 2002) to perform network analysis for joint projects. The network diagram, produced by using the UCINET software for social network analysis (Borgatti, Everett, Freeman, 2002), demonstrates inter-organizational collaboration and partnership in the projects initiated after the 1999 Earthquakes. Data gathered from official documents, professional reports, news analyses of *Cumhuriyet*, and the related web sites were used for this analysis.

[40] Interview with Bogazici University Earthquake Engineering, June 24, 2004
Interview with Turkish Amateur Radio Club, June 23, 2004



Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

Figure 8 Project Inter-organizational Network

Legend:

Acronym	**Organizations**	**Acronym**	**Organizations**
Bu-KOERI	Bogazici University, Kandilli Observatory and Earthquake Research Institute	Turk Pirelli	Turk Pirelli
ITU	Istanbul Technical University	Erickson	Erickson
METU	Middle East Technical University	Tuncmatik	Tuncmatik
Tubitak-MAM	TUBITAK Marmara Research Center	YBT	Yapisal Tasarim Hizmetleri
ITU-Cendm	ITU Center of Excellence for Disaster Management	TRAC	Turkish Ameteur Radio Club
ERD	GDDA Earthquake Research Center	AKUT	Search and Rescue Association
Tubitak	The Scientific and Technical research and Council Turkey	TFA	Turkish Firebrigade Association

Acronym	Organizations	Acronym	Organizations
Bu-Cendim	Bogazici University-Center for Disaster Management	KIZILAY	Turkish Red Crescent Society
GDDA	General Directorate of Turkish Disaster Affairs	Kizilay-AFOM	Kizilay-Emergency Coordination Center
GDTEM	General Directorate of Turkey Emergency Management	TNGGA	Turkish National Geophysics and Geodesy Association
BU	Bogazici University	BITA	Bolu Industrial and Trade Association
Ytu	Yildiz Technical University	SDC	Swiss Agency for Development and Cooperation
Ist. Uni.	Istanbul University	FEMA	Federal Emergency Management Agency, USA
GDCD	General Directorate of Civil Defense	NATO	North Atlantic Treaty Organization
PIU	Republic of Turkey Prime Ministry Project Implementation Unit	GMG	Gumulcine Municipality of Greece
Interior Ministry of Turkey	Interior Ministry of Turkey	SLF	Swiss Federal Institute of Snow and Avalanche Research
KOU	Kocaeli University	ETHZ-IGT	Swiss Federal Institute of Technology Zurich - Institute for Geotechnical Engineering
SAU	Sakarya University	EPFL-IS	Swiss Federal Institute Technology Lausanne
Firat Uni.	Firat University	ETHZ-IG	Swiss Federal Institute Technology Zurich
GCM	General Command of Mapping, Turkey	USGS	United Centrals Geological Survey
SHOD	Turkish Navy- Department of Navigation, Hydrography and Oceanography	USID-OFDA	United Centrals International Development Agency "Office of Foreign Disaster Assistance"
DMI	Central Meteorological Affairs	PSU	Penn Central University\
DSI	General Directorates of Central Hydraulic Works	CNR	National Research Council of Italy
MTA	General Directorate of Mineral Research and Exploration	NSSP	National Survey for Seismic Protection, Yerevan, Armenia
DPT	Central Planning Institution	DUTech	Darmstadt University of Tech.-Institute of Physics and Geodesy
TEDAS	Turkish Central Electricity Distribution Corp	JIPE	Joint Institute of Physics of the Earth, Moscow, Russia
Turk Telecom	Turk Telecom	FJG	Julich Research Center
EIE	General Directorate of Electrical Power Resources, Turkey	IRRS	Istituto di Ricerca sul Rischio Sismico, Milano, Italy
GDLRC	General Directorate of Land Registry and Cadastre	ING	Istituto Nazionale di Geofisica, Roma, Italy
GDI	General Directorate of Insurance	GII	Geophysical Institute of Israel
MPWS	Ministry of Public Works and Settlements	GI	Geophysics Institute, National Academy of Sciences, Kiev, Ukraine
GDSL	General Directorate of Central Land	GPG	Grevena Province Government, Greece
DEU	Dokuz Eylul University	IG-Tiblisi	Institute of Geophysics, Academy of Sciences, Tbilisi, Georgia
AIBU	Abant Izzet Baysal University	IG-Zurich	Institute of Geophysics, ETH Zurich, Switzerland
ZKU	Zonguldak Karaelmas Uni.	IMG	Institute of Marine Geology, Italy
Dicle Uni	Dicle Uni	IRM	Institute of Rock Mechanics, Academy of Sciences, Prague, Czech Republic
Selcuk Uni.	Selcuk Uni.	IIEES	International Institute of Earthquake Engineering and Seismology, Teheran, Iran
Karadeniz Uni.	Karadeniz Uni.	IIEPTMG	International Institute of Earthquake Prediction Theory and Mathematical Geophysics, Moscow, Russia
First Army Hd	First Army Headquarters	IS	Institute of Seismology, Academy of Sciences,

Acronym	Organizations	Acronym	Organizations
			Ashkhabad, Turkmenistan
IPG	Istanbul Province Government	EMGE	Experimental Methodical Geophysical Expedition, Academy of Sciences, Baku, Azerbaijan
KG	Kocaeli Government	ERR	Emilia Romagna Region, Italy
SG	Sakarya Government	GFZ	GeoForschungsZentrum, Potsdam, Germany
BG	Bursa Government	CSIC-Spain	Consejo Superior de Investigaciones Cientificas-Spain
YG	Yalova Government	ETHZ-Zurich	Swiss Seismological Service
Bolu Gov	Bolu Government	BKG	Bundesamt Kartographie und Geodasie
DG	Duzce Province Government	JICA	Japan International Cooperation Agency
Ankara CD	Ankara Civil Defense	US Red Cross	US Red Cross
Afyon CD	Afyon Civil Defense	MIT	Massachusetts Institute of Technology
Adana CD	Adana Civil Defense	UN	United Nations
Bursa CD	Bursa Civil Defense	WB	World Bank
Diyarbakir CD	Diyarbakir Civil Defense	French Team	French Team
Erzurum CD	Erzurum Civil Defense	EUREF	European Reference Frame
Istanbul CD	Istanbul Civil Defense	ESC	European Seismological Commission
Izmir CD	Izmir Civil Defense	DRM	The world Institute for Disaster management
Sakarya CD	Sakarya Civil Defense	TITech	Tokyo Institute of Technology
Samsun CD	Samsun Civil Defense	UNR	University of Nevada at Reno
Van CD	Van Civil Defense	UP	University of PA
SAR	Search and Rescue	IFRC	International Federation of Red Cross
Izmit KK	Izmit Kent Kurultayi	VT	Virginia Institute of Technology
Izmit CD	Izmit Civil Defense	WRMDC	Wharton Risk Management and Decision Center
IBB	Istanbul Metropolitan Municipality	Kyoto Uni	Kyoto University
Yalova Mun	Yalova Municipality	LDEO	Lamont-Doherty Earth Observatory, Colombia University
Izmir Mun	Izmir Municipality	ISSMGE	International Society of Soil Mechanics and Geotechnical Engineering
Bursa Mun	Bursa Municipality	EAEE	European Association of Earthquake Engineering
Kocaeli Mun	Kocaeli Municipality	EIB	European Investment Bank
Sakarya Mun	Sakarya Municipality	ESA	European Space Agency
Bolu Mun	Bolu Municipality	EUF	European Union Fund
Duzce Mun	Duzce Municipality	Negro of JRC-Ispra	Environmental Institute for Health and Consumer Protection
Avcilar Mun	Avcilar Municipality	CHRR	Center for Hazard and Risk Research- Colombia University
District M	Diztrict Municipalities	UNAVCO	University NAVSTAR Consortium
DCMC	District Crisis Management Center	SSTL	Surrey Satellite Technology Limited
Siemens	Siemens	GS&EEC	GeoSig&Electrowatt Ekono Cons
Sika	Sika	ECC	Exandas Consultant Comp
Unilever	Unilever	Munich Regroup	Munich Regroup
CW	Corliss Willis	Studer Eng.	Studer Engineering
CAR	Cambridge Architectural Research Limited	LEL&OC-UK	London Economics Limited and Oracle Corporation UK Ltd
CSFB	Credit Suisse First Boston	Sumitomo Co.	Sumitomo Corporation

Figure 8 depicts interactions among the national and international organizations for preparation and implementation of the projects. The figure provides a quick snapshot of the network. Organizations have different positions depending on their degree of involvement in the projects. Before analyzing the centrality data, one can easily observe from the figure that some organizations are key actors in the network: Bogazici University Kandilli Observatory and Earthquake Engineering (BU-KOERI), Istanbul Metropolitan Municipality (IBB), Istanbul Province Government (IPG), Istanbul Technical University (ITU), Middle East Technical University (METU), ITU- Disaster Management Center (ITU-Cendim). The Scientific and Technical Research and Council of Turkey (TUBITAK), the TUBITAK-Marmara Research Center (TUBITAK-MAM), the General Directorate of Disaster Affairs (GDDA), the Prime Ministry of Project Implementation Unit (PIU), and the General Directorate of Civil Defense are the other most central organizations. European Seismological Commission (ESC) appears to be the most central international organizations. Kizilay and Turkish Amateur Radio Association (TRAC) are the most active national nonprofit organizations in the network. It is understandable that research institutions (*e.g.* BU-KOERI, Metu, Itu, TUBITAK) are key actors in the project network.

7.4.1 Centrality

7.4.1.1 Degree Centrality

The measurement of Freeman's degree centrality shows which organization has the most central role in the joint projects. Out-Degree and In-Degree data document the position of an organization in the network. If an organization is the main organization which develops the project, and unites with others for this purpose, its Out-Degree value grows higher. If an organization participates in a project developed by others and joins with other organizations for this purpose, its In-Degree value becomes higher. Table 38 shows the 10 most central organizations in terms of degree centrality in the project network (see Appendix G, Table 1 for Freeman's degree centrality data for all organizations).

Table 38 indicates that Bogazici University Kandilli Observatory and Earthquake Engineering (actor #1) is the most central organization with more ties (38) to others than any other organization. The BU-KOERI has the second highest Out-Degree centrality score, 29, (the same as TUBITAK-MAM) and in-degree centrality value of 9, (the same as TUBITAK and METU). BU-KOERI is the most active organization in the network that initiates projects and cooperates in other projects that are developed by other organizations (see Figure 9).

Table 38 also present descriptive analyses and network centralization of the project network. According to these statistics, on the average, organizations have a degree of 1.81, and Freeman's graph centralization measure indicates that the project network has 2.03% in-degree, and 4.69% out-degree centrality. These statistics show there is not a substantial centralization, or concentration in the network. The power of centrality is distributed among organization such as BU-KOERI, TUBITAK, ITU, IBB, GDDA, ESC, PIU.

According to Table 38, the European Seismological Commission (actor #76), has the highest out-degree centrality (30) and the third highest total degree centrality; however, it does not have any in-degree centrality.[41] Therefore, the ESC is in the central position in its local neighborhood, and can be treated as an outlier. Figure 10 shows that the BU-KOERI is the key organization that connects the ESC to the whole network.

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[41] There are only two projects that ESC coordinates. These projects are located in large regions of Europe, Africa, and Near-Asia.

Table 38 Freeman's Degree Centrality for the Project Network

Actor#		OutDegree	InDegree	NrmOutDeg	NrmInDeg
76	ESC	30.000	0.000	4.902	0.000
1	BU-KOERI	29.000	9.000	4.739	1.471
5	TUBITAK-MAM	29.000	8.000	4.739	1.307
2	IBB	21.000	7.000	3.431	1.144
20	PIU	21.000	0.000	3.431	0.000
12	GDDA	17.000	2.000	2.778	0.327
6	ITU-Cendm	15.000	0.000	2.451	0.000
3	ITU	13.000	14.000	2.124	2.288
35	GCM	13.000	3.000	2.124	0.490
19	GDCD	11.000	2.000	1.797	0.327

DESCRIPTIVE STATISTICS

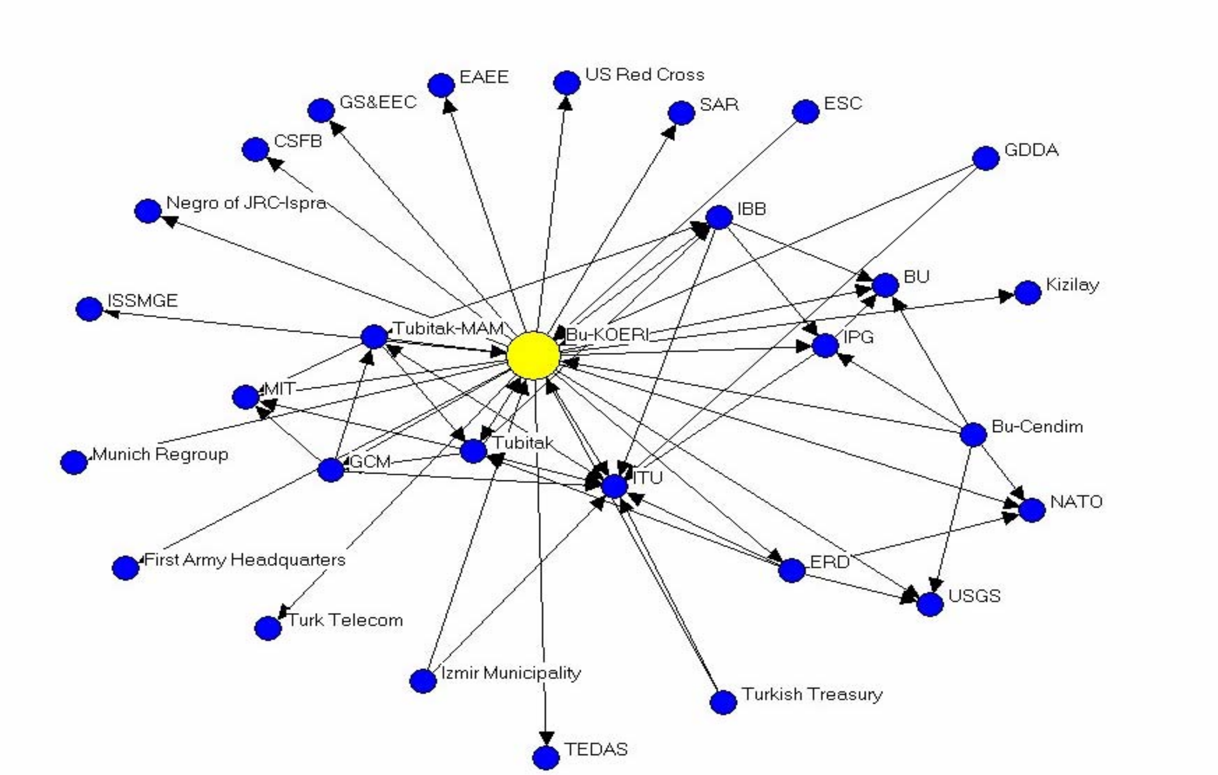
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
1	Mean	1.831	1.831	0.299	0.299
2	Std Dev	5.393	1.937	0.881	0.316
3	Su	282.000	282.000	46.078	46.078
4	Variance	29.088	3.751	0.777	0.100
5	SSQ	4996.000	1094.000	133.389	29.209
6	MCSS	4479.610	577.610	119.602	15.422
7	Euc Norm	70.682	33.076	11.549	5.405

Network Centralization (Outdegree) = 4.695%

Network Centralization (Indegree) = 2.028%

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
ESC: European Seismological Commission
BU-KOERI: Bogazici University Kandilli Observatory and Earthquake Engineering
TUBITAK-MAM: The Scientific and Technical Research and Council of Turkey Marmara Research Center
PIU: Prime Ministry of Project Implementation Unit
IBB: Istanbul Metropolitan Municipality
GDDA: General Directorate of Disaster Affairs
GDCD: General Directorate of Civil Defense
ITU: Istanbul Technical University
ITU-Cendim: ITU- Disaster Management Center
GCM: General Command of Mapping

Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)



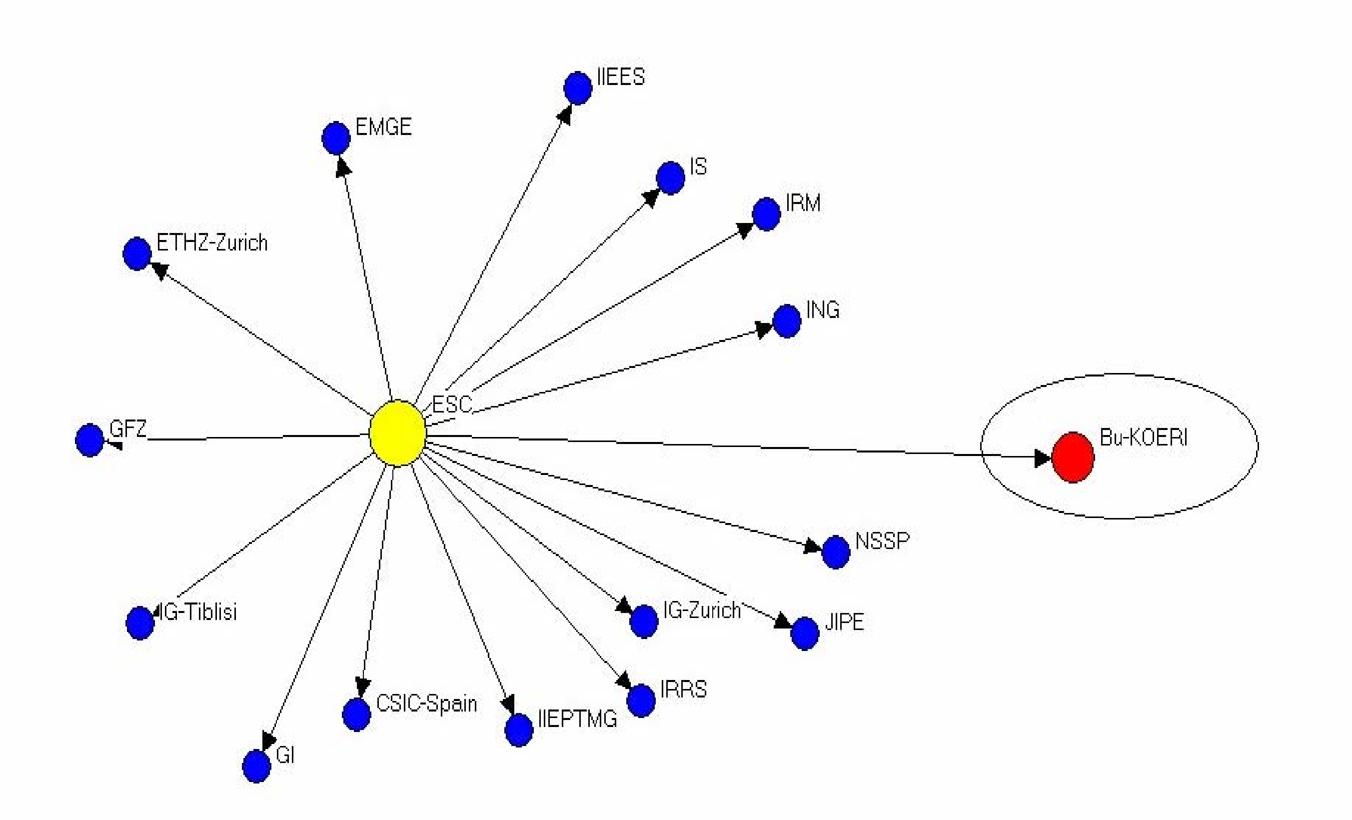
Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

Figure 9 Ego Network for BU-KOERI

Legend:

Acronym	Organizations
Bu-KOERI	Bogazici University, Kandilli Observatory and Earthquake Research Institute
ITU	Istanbul Technical University
METU	Middle East Technical University
Tubitak-MAM	TUBITAK Marmara Research Center
ERD	GDDA Earthquake Research Center
Tubitak	The Scientific and Technical research and Council Turkey
Bu-Cendim	Bogazici University-Center for Disaster Management
BU	Bogazici University
GCM	General Command of Mapping
MIT	Massachusetts Institute of Technology
IPG	Istanbul Province Government
Bu-Cendim	Bogazici University-Center for Disaster Management
GDDA	General Directorate of Turkish Disaster Affairs
IBB	Istanbul Metropolitan Municipality
First Army Headquarters	First Army Headquarters
Turk Telecom	Turk Telecom
Turk Treasury	Turk Treasury
KIZILAY	Turkish Red Crescent Society
SAR	Search and Rescue
Izmir Mun	Izmir Municipality
TEDAS	Turkish Central Electricity Distribution Corp
US Red Cross	US Red Cross
NATO	North Atlantic Treaty Organization
Negro of JRC-Ispra	Environmental Institute for Health and Consumer Protection
ISSMGE	International Society of Soil Mechanics and Geotechnical Engineering
EAEE	European Association of Earthquake Engineering

Acronym	Organizations
Negro of JRC-Ispra	Environmental Institute for Health and Consumer Protection
GS&EEC	GeoSig&Electrowatt Ekono Cons
ESC	European Seismological Commission
USGS	United Centrals Geological Survey
CSFB	Credit Suisse First Boston
Munich Regroup	Munich Regroup



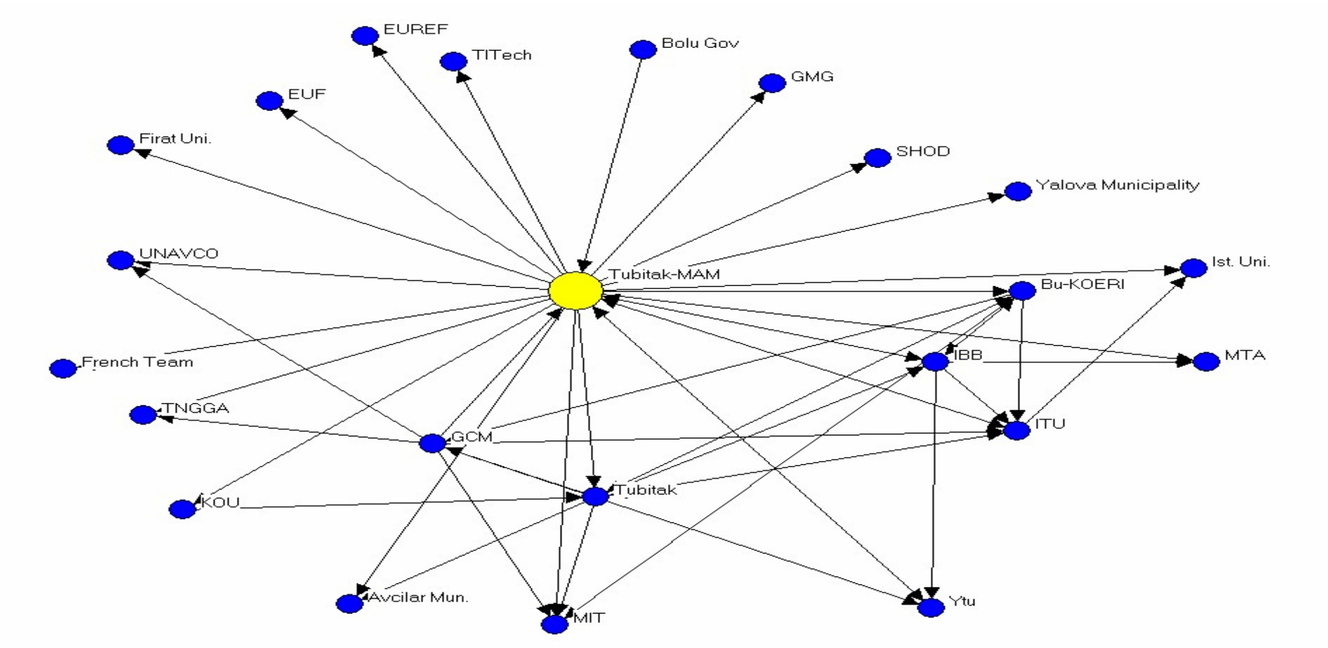
Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

Figure 10 EGO Network for ESC

Legend:

Acronym	Organizations
ESC	European Seismological Commission
Bu-KOERI	Bogazici University, Kandilli Observatory and Earthquake Research Institute
NSSP	National Survey for Seismic Protection, Yerevan, Armenia
JIPE	Joint Institute of Physics of the Earth, Moscow, Russia
IRRS	Istituto di Ricerca sul Rischio Sismico, Milano, Italy
ING	Istituto Nazionale di Geofisica, Roma, Italy
GI	Geophysics Institute, National Academy of Sciences, Kiev, Ukraine
IG-Tiblisi	Institute of Geophysics, Academy of Sciences, Tbilisi, Georgia
IG-Zurich	Institute of Geophysics, ETH Zurich, Switzerland
IRM	Institute of Rock Mechanics, Academy of Sciences, Prague, Czech Republic
IIEES	International Institute of Earthquake Engineering and Seismology, Teheran, Iran
IIEPTMG	International Institute of Earthquake Prediction Theory and Mathematical Geophysics, Moscow, Russia
IS	Institute of Seismology, Academy of Sciences, Ashkhabad, Turkmenistan

Acronym	Organizations
EMGE	Experimental Methodical Geophysical Expedition, Academy of Sciences, Baku, Azerbaijan
GFZ	GeoForschungsZentrum, Potsdam, Germany
CSIC-Spain	Consejo Superior de Investigaciones Cientificas-Spain
ETHZ-Zurich	Swiss Seismological Service



Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

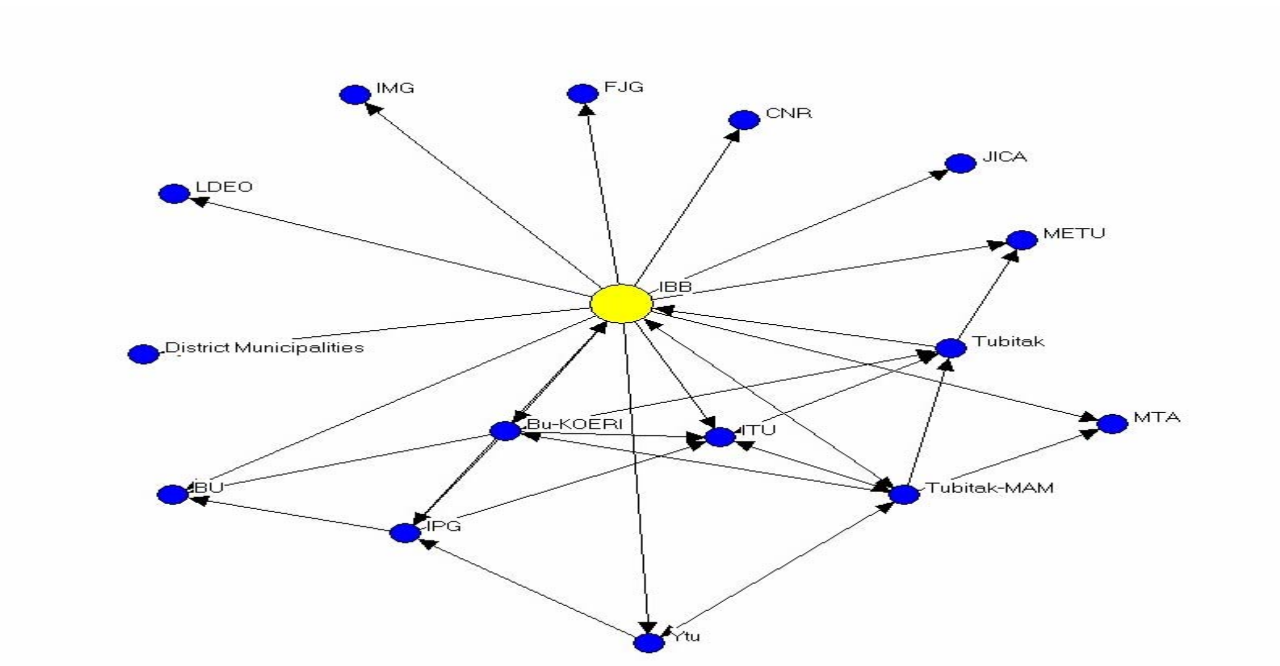
Figure 11 Ego Network for TUBITAK-MAM

Legend:

Acronym	Organizations
Bu-KOERI	Bogazici University, Kandilli Observatory and Earthquake Research Institute
ITU	Istanbul Technical University
METU	Middle East Technical University
Tubitak-MAM	TUBITAK Marmara Research Center
Tubitak	The Scientific and Technical research and Council Turkey
Ytu	Yildiz Technical University
Ist Uni.	Istanbul University
KOU	Kocaeli University
Firat Uni.	Firat University
GCM	General Command of Mapping, Turkey
MTA	General Directorate of Mineral Research and Exploration
SHOD	Turkish Navy- Department of Navigation, Hydrography and Oceanography
TNGGA	Turkish National Geophysics and Geodesy Association
Bolu Gov	Bole Government
Avcilar Mun.	Avcilar Municipality
Yalova Mun.	Yalova Municipality
French Team	French Team
MIT	Massachusetts Institute of Technology
UNAVCO	University NAVSTAR Consortium

Acronym	Organizations
EUREF	European Reference Frame
TITech	Tokyo Institute of Technology
GMG	Gumulcine Municipality of Greece
EUF	European Union Fund

Excluding ESC, the TUBITAK-MAM (37) and Istanbul Metropolitan Municipality (28) follow BU-KOERI. The TUBITAK-MAM has 29 out-degree and 8 in-degree centrality (Figure 11), whereas IBB has 21 out-degree and 7 in-degree centrality (Figure 12).



Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

Figure 12 Network for Istanbul Metropolitan Municipality

Legend:

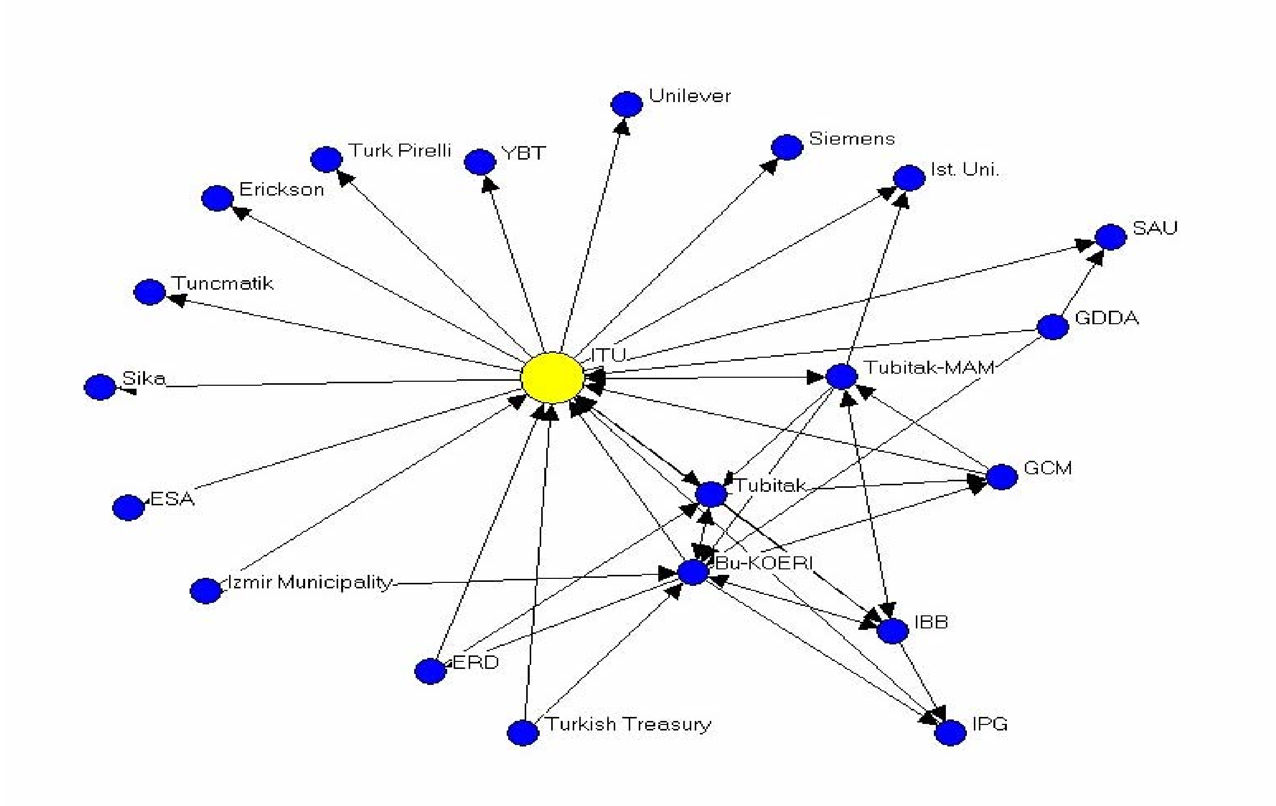
Acronym	Organizations
IBB	Istanbul Metropolitan Municipality
Bu-KOERI	Bogazici University, Kandilli Observatory and Earthquake Research Institute
ITU	Istanbul Technical University
METU	Middle East Technical University
Tubitak-MAM	TUBITAK Marmara Research Center
Tubitak	The Scientific and Technical research and Council Turkey
BU	Bogazici University
District Mun	District Municipalities
MIT	Massachusetts Institute of Technology
IPG	Istanbul Province Government
Ytu	Yildiz Technical University
MTA	General Directorate of Mineral Research and Exploration

Acronym	Organizations
FJG	Julich Research Center
LDEO	Lamont-Doherty Earth Observatory, Colombia University
JICA	Japan International Cooperation Agency
CNR	National Research Council of Italy
IMG	Institute of Marine Geology, Italy

Istanbul Technical University (27), the Project Implementation Unit of Turkish Prime Ministry (21) and the General Directorate of Disaster Affairs (19) are other public-province and public central organizations that have the most central position in the network after the first four organizations. Those organizations are the most central organizations that develop and contribute to the projects.

ITU has the biggest in-degree centrality (14) (Figure 13), followed by BU-KOERI (actor #1), the TUBITAK (actor #7), and the Middle East Technical University (actor #4), each with in-degree centrality value of 9. Therefore, those organizations are the main organizations that join projects developed by other organizations in the network.

According to Table 1 (see Appendix G), ESC (actor#76), the Prime Ministry Project Implementation Unit (PIU, actor#20), ITU-Disaster Management Center (ITU-Cendim, actor#6), the Turkish Treasury (actor#26), and Bolu Government (actor#56) do not have any in-degree centrality whereas the METU, and the Bogazici University (BU, actor#11) do not have any out-degree centrality. Interestingly, the General Directorate of Turkey Emergency Management (GDTEM, actor #13) mandated with coordination of disaster affairs is not among the most central organizations in the network.



Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

Figure 13 Ego Network for ITU Sources

Legend:

Acronym	Organizations
Bu-KOERI	Bogazici University, Kandilli Observatory and Earthquake Research Institute
ITU	Istanbul Technical University
METU	Middle East Technical University
Tubitak-MAM	TUBITAK Marmara Research Center
ERD	GDDA Earthquake Research Center
Tubitak	The Scientific and Technical research and Council Turkey
GCM	General Command of Mapping
IPG	Istanbul Province Government
GDDA	General Directorate of Turkish Disaster Affairs
IBB	Istanbul Metropolitan Municipality
Ist Uni.	Istanbul University
SAU	Sakarya University
Turkish Treasury	Turkish Treasury
Izmir Mun.	Izmir Municipality
Siemens	Siemens
Sika	Sika
Unilever	Unilever
Turk Pirelli	Turk Pirelli
Erickson	Erickson
Tuncmatik	Tuncmatik
YBT	Yapisal Tasarim Hizmetleri

Acronym	Organizations
Turk Pirelli	Turk Pirelli
ESA	European Space Agency

The European Seismological Commission is the only international agency among the most central organizations. TRAC, Kizilay and Kizilay-AFOM are the most central national nonprofit organizations. In terms of jurisdictions, public-central organizations have significantly higher centrality degree than public-province ones. Istanbul Metropolitan Municipality is the only municipality that has a notable centrality degree.

7.4.1.2 Closeness Centrality

Closeness centrality not only measures the distance of an organization to all other organizations, but also measures the shortest distance from each organization to all others in the project network. Table 39 presents data on the degree of closeness centrality for the ten most central organizations in the project network (see Appendix G, Table 2 for closeness centrality data for all organizations).

As shown in Table 39, BU-KOERI is the most central organization with the highest degree of closeness centrality (44.868), and the sum of its farness score from other organizations is the least (341). The General Directorate of Disaster Affairs (GDDA) follows BU-KOERI with a total farness degree of 361. Istanbul Technical University (ITU) with a farness degree of 367, the TUBITAK-Marmara Research Center with a farness degree of 385 and the Istanbul Metropolitan Municipality with a farness degree of 394 come after the first two organizations, respectively.

Table 39 Closeness Centrality for the Project Network

Actor#		Farness	nCloseness
1	BU-KOERI	341.000	44.868
12	GDDA	361.000	42.382
3	ITU	367.000	41.689
5	TUBITAK-MAM	385.000	39.740
2	IBB	394.000	38.832
8	IPG	415.000	36.867
20	PIU	417.000	36.691
7	TUBITAK	426.000	35.915
40	Kizilay	434.000	35.253
4	METU	436.000	35.092

Statistics

		Farness	nCloseness
1	Mean	549.779	28.448
2	Std Dev	80.690	4.337
3	Sum	84666.000	4380.983
4	Variance	6510.847	18.811
5	SSQ	47550280.000	127526.906
6	MCSSQ	1002670.500	2896.943
7	Euc Norm	6895.671	357.109
8	Minimum	341.000	17.019
9	Maximum	899.000	44.868

Network Centralization = 33.44%

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
IPG: Istanbul Province Government
BU-KOERI: Bogazici University Kandilli Observatory and Earthquake Engineering
TUBITAK-MAM: The Scientific and Technical Research and Council of Turkey Marmara Research Center
PIU: Prime Ministry of Project Implementation Unit
IBB: Istanbul Metropolitan Municipality
GDDA: General Directorate of Disaster Affairs
TUBITAK: The Scientific and Technical Research and Council of Turkey
ITU: Istanbul Technical University
Kizilay: Turkish Red Crescent
METU: Middle East Technical University

Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

In terms of jurisdictions, the public-central organizations are more central in the network than the public-province organizations. Eight of ten organizations that have the least farness degrees are the public-central organizations, whereas only one of ten (Istanbul Province

Government) is a public-province organization. Istanbul Metropolitan Municipality is the only municipality among the ten most central organizations. Two national nonprofit organizations, Turkish Amateur Radio Club and the Turkish Red Crescent Society, are among the twenty most central organizations.

The data reveal that the European Seismological Commission is a local central organization in the network. The ESC is the nineteenth most central organization in terms of closeness centrality, while it is the only international and third most central organization in terms of degree centrality. The table shows that international organizations are more central when all ties rather than only immediate ties are considered (see Appendix G, Table 2). There are three international organizations, the ESC, Massachusetts Institute of Technology, Japan International Coordination Agency, among the most central organizations.

The network centralization index shows a considerably large (33.44%) degree of concentration in the whole network. This indicates organizations such as Bu-KOERI, GDDA, ITU, and TUBITAK-MAM were involved in considerable numbers of projects in the network.

7.4.1.3 Betweenness Centrality

Table 40 cites data on betweenness centrality for the project network. The table lists 18 organizations that have at least (1.000) score of betweenness centrality degree. All other organizations in the network have (0) score of betweenness centrality (see Appendix G, Table 3 for betweenness centrality data for all organizations).

According to Table 40, Bogazici University Kandilli Observatory and Earthquake Engineering (actor #1), Istanbul Technical University (actor #3), and TUBITAK-Marmara Research Center (actor # 5) have the highest degree of betweenness centrality, suggesting that more organizations depend on them to connect with other organizations in the network.

TUBITAK (actor #7), Istanbul Metropolitan Municipality (actor #2), General Directorate of Disaster Affairs (actor #12), General Command of Mapping (actor #35), Kocaeli University (actor #27), and Istanbul Province Government (actor #8) follow the first three organizations.

Although the Project Implementation Unit of Turkish Prime Ministry (actor #20) is the sixth most central organization according to the Freeman's degree centrality, it is not among the main organizations according to the betweenness centrality data. The General Directorate of Turkey Emergency Management (GDTEM, actor #13) is again not among the most central organizations in the network in terms of betweenness centrality.

Moreover, like the Freeman's degree centrality data, there is one international organization, Swiss Agency for Development and Cooperation (actor #21) among the first 18 organizations that fall on the shortest pathway between other pairs of organizations in the network.

In terms of jurisdictions, 11 of 18 organizations that have the highest betweenness centrality score are the public-central organizations. There are two public-province governments, Istanbul Province Government and Sakarya Government, and two province municipalities, Istanbul Metropolitan Municipality and Duzce Municipality, and two national nonprofit organizations, TRAC and Kizilay among the most central organizations as measured by betweenness centrality.

The graph centralization present a 2.24% index degree that shows the network is not centralized. It indicates that organizations interact with other without assistance of intermediary actors.

Table 40 Betweenness Centrality for the Project Network

Actor#		Betweenness	nBetweenness
1	BU-KOERI	538.767	2.317
3	ITU	417.700	1.796
5	TUBITAK-MAM	413.700	1.779
7	TUBITAK	323.283	1.390
2	IBB	180.583	0.777
12	GDDA	156.500	0.673
35	GCM	141.117	0.607
27	KOU	105.000	0.451
8	IPG	98.333	0.423
14	Ytu	42.067	0.181
19	GDCD	33.000	0.142
9	ERD	31.450	0.135
40	Kizilay	20.000	0.086
21	SDC	18.000	0.077
33	TRAC	18.000	0.077
38	Sakarya Gov.	5.000	0.021
138	GDLRC	2.500	0.011
34	Duzce Mun.	1.000	0.004

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		Betweenness	nBetweenness
1	Mean	16.532	0.071
2	Std Dev	72.118	0.310
3	Sum	2546.000	10.948
4	Variance	5200.973	0.096
5	SSQ	843041.500	15.588
6	MCSSQ	800949.875	14.809
7	Euc Norm	918.173	3.948
8	Minimum	0.000	0.000
9	Maximum	538.767	2.317

Network Centralization Index = 2.24%

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
BU-KOERI: Bogazici University Kandilli Observatory and Earthquake Engineering
TUBITAK: The Scientific and Technical Research and Council of Turkey
TUBITAK-MAM: Marmara Research Center of Tubitak
IBB: Istanbul Metropolitan Municipality
GDDA: General Directorate of Disaster Affairs
GDCD: General Directorate of Civil Defense
ITU: Istanbul Technical University
YTU: Yildiz Technical University
GCM: General Command of Mapping
IPG: Istanbul Province Government
Kizilay: Turkish Red Crescent
KOU: Kocaeli University
ERD: Earthquake Research Department
TRAC: Turkish Radio Amateur Club
Sakarya Gov.: Sakarya Province Government
GDLRC: General Directorate of Land Registry and Cadastre
Duzce Mun. : Duzce Municipality
SDC: Swiss Agency for Development and Cooperation

Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

7.4.1.4 Flow Betweenness Centrality

Table 41 cites data on flow betweenness centrality for the project network. The table presents data on 17 organizations that have scores of at least 1.000 on flow betweenness centrality. All other organizations in the network have a score of 0.000 on flow betweenness centrality (see Appendix G, Table 4 for flow betweenness centrality data for all organizations).

According to the flow betweenness centrality table, Bogazici University Kandilli Observatory and Earthquake Engineering (actor #1) has the highest centrality degree, indicating that BU-KOERI is the most important mediator in the network. Similar to the betweenness centrality data, Istanbul Technical University (actor #3) and the TUBITAK-MAM (actor # 5) follow BU-KOERI. TUBITAK (actor #7), Istanbul Metropolitan Municipality (actor #2), Istanbul Province Government (actor #8), Kocaeli University (actor #27), General Command of Mapping (actor #35), and General Directorate of Disaster Affairs (actor #12) fall below the first three organizations.

With respect to jurisdictions, 10 of 17 organizations that have the highest betweenness centrality score are public-central organizations. According to Tables 28 and 29, betweenness centrality and flow betweenness centrality data reveal similar results about province governments, province municipalities and the national nonprofit organizations as they include the same provincial, local and nonprofit organizations. Swiss Agency for Development and Cooperation (actor #21) is once more the only international organization among the first 17 organizations with a high score of flow betweenness centrality.

Table 41 Flow Betweenness Centrality for the Project Network

Actor#		FlowBet	nFlowBet
1	BU-KOERI	916.077	3.939
3	ITU	363.852	1.565
5	TUBITAK-MAM	331.182	1.424
7	TUBITAK	219.336	0.943
2	IBB	135.064	0.581
8	IPG	117.292	0.504
27	KOU	107.976	0.464
35	GCM	101.755	0.438
12	GDDA	77.333	0.333
9	ERD	69.743	0.300
14	Ytu	42.142	0.181
33	TRAC	11.333	0.049
21	SDC	4.833	0.021
138	GDLRC	1.333	0.006
34	Duzce Mun.	1.000	0.004
38	Sakarya Gov.	1.000	0.004
40	Kizilay	1.000	0.004

Network Centralization Index = 3.895%

		FlowBet	nFlowBet
1	Mean	16.248	0.070
2	Std Dev	86.622	0.372
3	Sum	2502.252	10.760
4	Variance	7503.299	0.139
5	SSQ	1196165.750	22.117
6	MCSSQ	1155508.125	21.365
7	Euc Norm	1093.694	4.703

SSQ : Sum of Squares
MCSSQ: Mean Centered Sum of Squares
Euc Norm: Euclidian Norm
BU-KOERI: Bogazici University Kandilli Observatory and Earthquake Engineering
TUBITAK-MAM: The Scientific and Technical Research and Council of Turkey Marmara Research Center
IBB: Istanbul Metropolitan Municipality
GDDA: General Directorate of Disaster Affairs
ITU: Istanbul Technical University
YTU: Yildiz Technical University
GCM: General Command of Mapping
IPG: Istanbul Province Government
TUBITAK: The Scientific and Technical Research and Council of Turkey
Kizilay: Turkish Red Crescent, KOU: Kocaeli University
ERD: Earthquake Research Department, TRAC: Turkish Radio Amateur Club
Sakarya Gov.: Sakarya Province Government
GDLRC: General Directorate of Land Registry and Cadastre
Duzce Mun. : Duzce Municipality
SDC: Swiss Agency for Development and Cooperation

Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

The final centrality measurement indicates that the General Directorate of Turkey Emergency Management (GDTEM, actor #13) is not among the most central organizations in the network. Although there are only seven national nonprofit organizations in the whole network, it is certain that two national nonprofit organizations, TRAC and Kizilay, are the most central organizations among all 154 organizations in the network based upon four different centrality measurements.

The betweenness centrality and flow betweenness statistics show a relatively low index of graph centralizations. Network centralization for betweenness centrality is 2.24%, whereas for flow betweenness centrality is 3.89%. These data show that many organizations interact with others without using intermediary actors.

7.4.2 Cliques

Table 42 lists the cliques (subgroups) identified in the project network. The data exhibit sub-network structures within the larger network. Since we assume that the larger network supports the emergence of subgroups, this table gives us applicable data to understand the features of the whole network. According to the table, there are 33 cliques that contain at least three or more members.

The three largest cliques are composed of five organizations. Seven of the 33 cliques have four members. The remainder of the cliques (23) in the table is composed of three organizations. Of 154 national and international organizations, only 38 have a clique membership. The remaining 116 organizations are isolated.

Table 42 Cliques for the Project Network

1: BU-KOERI IBB ITU TUBITAK-MAM TUBITAK
2: BU-KOERI ITU TUBITAK-MAM TUBITAK GCM
3: BU-KOERI ITU TUBITAK ERD
4: BU-KOERI IBB ITU IPG
5: BU-KOERI ITU GDDA
6: BU-KOERI ITU Turkish Treasury
7: BU-KOERI ITU Izmir Municipality
8: BU-KOERI IPG Bu-Cendim BU
9: BU-KOERI Bu-Cendim NATO
10: BU-KOERI Bu-Cendim USGS
11: BU-KOERI IBB IPG BU
12: BU-KOERI ERD NATO
13: BU-KOERI TUBITAK-MAM TUBITAK MIT GCM
14: BU-KOERI ERD USGS
15: METU TUBITAK ERD Kizilay-AFOM
16: IBB METU TUBITAK
17: METU TUBITAK GCM
18: ITU-Cendm GDTEM TRAC
19: ITU-Cendm TRAC Kizilay
20: ITU-Cendm GDDA JICA
21: IBB IPG YTU
22: IBB TUBITAK-MAM YTU
23: TUBITAK-MAM YTU GCM
24: ITU TUBITAK-MAM Ist. Uni.
25: PIU WB GDLRC
26: GDDA SDC Kocaeli Gov.
27: TUBITAK-MAM TUBITAK KOU
28: ITU GDDA SAU
29: Kizilay Kizilay-AFOM UN
30: IBB TUBITAK-MAM MTA
31: TUBITAK-MAM TUBITAK Avcilar Mun.
32: TUBITAK-MAM GCM TNGGA
33: TUBITAK-MAM GCM UNAVCO

Sources: Official Websites of Turkish Disaster Organizations, Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004), *Cumhuriyet* News Reports Academic and Professional Reports (see the full list in Appendix C)

Legend:

Acronym	Organizations	Acronym	Organizations
Bu-KOERI	Bogazici University, Kandilli Observatory and Earthquake Research Institute	USGS	United Centrals Geological Survey
ITU	Istanbul Technical University	KG	Kocaeli Government
METU	Middle East Technical University	TNGGA	Turkish National Geophysics and Geodesy Association
Tubitak-MAM	TUBITAK Marmara Research Center	TRAC	Turkish Ameteur Radio Club
ITU-Cendm	ITU Center of Excellence for Disaster Management	AKUT	Search and Rescue Association
ERD	GDDA Earthquake Research Center	KIZILAY	Turkish Red Crescent Society
Tubitak	The Scientific and Technical research and Council Turkey	Kizilay-AFOM	Kizilay-Emergency Coordination Center
Bu-Cendim	Bogazici University-Center for Disaster Management	SDC	Swiss Agency for Development and Cooperation
GDDA	General Directorate of Turkish Disaster Affairs	NATO	North Atlantic Treaty Organization
GDTEM	General Directorate of Turkey Emergency Management	MIT	Massachusetts Institute of Technology
BU	Bogazici University	UN	United Nations
Ytu	Yildiz Technical University	WB	World Bank
Ist. Uni.	Istabul University	JICA	Japan International Cooperation Agency
GDCD	General Directorate of Civil Defense	UNAVCO	University NAVSTAR Consortium
PIU	Republic of Turkey Prime Ministry Project Implementation Unit	GCM	General Command of Mapping, Turkey
KOU	Kocaeli University	GDLRC	General Directorate of Land Registry and Cadastre
SAU	Sakarya University	IPG	Istanbul Province Government
IBB	Istanbul Metropolitan Municipality	Avcilar Mun	Avcilar Municipality

According to Table 42, BU-KOERI (actor #1) is the main organization with the highest number of clique memberships (14). The second key organization, TUBITAK-MAM (actor #5), is a member of 11 cliques. The total number of clique memberships is 9 for ITU (actor #3) and TUBITAK , 7 for IBB (actor #2), 6 for GCM (actor #35), 4 for IPG (actor #8), 4 for ERD (actor #9), and 3 for METU (actor #4), ITU-Cendim (actor #6), BU-Cendim (actor #10), GDDA (actor #12), and YTU (actor #14).

In terms of jurisdictions, the public-central organizations play remarkably more important roles in the cliques than any other type of organizations. Thirty-two of 33 cliques have at least one public-central organization. According to Table 30, municipalities are the second most important actors in subgroups. Eight of 33 cliques have municipalities whereas five of 33 cliques have a public-province government organization. Avcilar municipality (actor #49) is the only district organization in the cliques.

Six international organizations (MIT, USGS, NATO, JICA, UNAVCO, SDC) are members of 8 cliques. Three national nonprofit organizations (Kizilay, Kizilay-AFOM, and TRAC) identified as three most central nonprofit organizations in terms of degree, closeness, betweenness and flow betweenness centrality are the member of at least one clique.

Interestingly, the General Directorate of Civil Defense (actor #17), the main organization responsible for rescue operations after a disaster occurs, is isolated from the cliques. The other key organization, General Directorate of Turkey Emergency Management (GDTEM, actor #13), shares only one clique membership with ITU-Cendim (actor #6) and TRAC (actor #33). This shows that organizations with coordination responsibilities do not effectively perform their duties regarding coordination.

7.5 ASSESSMENT OF JOINT PROJECTS AND PROJECT NETWORK ANALYSIS

Although there have been significant efforts after the 1999 earthquakes, Turkey is still at the beginning of the process in managing seismic risk. The respondent organizations acknowledge that there have been considerable improvements in realizing the great danger of seismic risk. However, they assert that the Turkish disaster administration is not ready for a possible Istanbul earthquake. Most of the efforts have focused on the later stage of disasters, and there are many tasks that have to be completed to prepare the administration and public for future disasters. Public-central (*e.g.* research institutions) are at the center of these developments with considerable technical and financial assistance from international. While some provincial organizations (e.g. Istanbul, Sakarya, Kocaeli Province Government) and Istanbul Metropolitan Municipalities highly engaged in these projects, district organizations were not able to join these attempts due to financial, technical, personnel constraints.

In light of all data gathered, the respondents were asked to evaluate the present capacity of the Turkish disaster system should a major earthquake occur. Table 43 presents data regarding the preparedness of the Turkish disaster system, from the perspective of respondent organizations.

Table 43 The Level of Readiness for Future Disasters

To what extent is the Turkish disaster system ready for future catastrophic earthquakes		
	N	%
Great extent	0	0
Good extent	3	7.7
Neither good or bad	14	35.9
Less than good	16	41
Not at all good	6	15.4
Total responses	39	100

N=Number of Responses; %=Percentage of Responses
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

None of the respondents believe that the Turkish disaster system is, to the highest degree, ready for a major future earthquake. Only three of the respondents (7.7%) said that the Turkish disaster system is well prepared for a major earthquake. These respondents emphasized in their assessment that the disaster system is ready for response and recovery/relief operations. One of the respondents claimed that the Turkish disaster management is more prepared for a future earthquake than any other nation that has similar seismic risk and economic conditions.[42]

[42] Interview with Duzce Province Government, June 14, 2004

> "…We are ready for rescue operations. Next time, the coordination and rescue efforts will be definitely much better. We are also very prepared for recovery and relief stages. We can do our best."

However, 41% of the interviewees claimed that the Turkish disaster system is at a less than good position to cope with destructive consequences of a major earthquake whereas 15.4% of them claimed that the system is not ready at all. If the Turkish public administration does not implement the required tasks, some claim that a future earthquake in Istanbul will be deadlier than the Marmara earthquake.[43]

> "…Yes, we can save more people now if an earthquake occurs. But how many people you would rescue: three hundred or maximum five hundreds. Of course, saving one more life is very important. But if an earthquake happens in Istanbul, we will probably lose many more people. The number of illegal buildings is still increasing very fast. We should stop this, and rebuild, or fix many old buildings. Regulations should allow us to force people to obey earthquake resistant codes…We have to change a lot. It is becoming late".

7.6 SUMMARY

This chapter reviewed the joint projects initiated after the 1999 earthquakes. The analysis showed that the Turkish public administration began to understand the problem of seismic risk. National and international organizations invested in technical and organizational aspects of the disaster system. Attempts to improve the informational infrastructure are considerable. Public-central organizations, especially research institutions, played significant roles in this regard.

In the second part, I analyzed the joint projects that are developed after the 1999 Marmara and Duzce earthquakes. The research identified 93 projects that aimed to increase the

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[43] Interview with Emergency Coordination Center, Istanbul Metropolitan Municipality, June 22, 2004

capacity of the disaster system from earthquake monitoring to emergency response and recovery phases.

Then, I analyzed the network characteristics of organizations involved in projects. Inferences from analyses expose some gaps in the Turkish disaster system. The system remains very centralized. District governments and municipalities play very insignificant roles in the system. Moreover, nonprofit and private organizations are not considered as parts of the system.

Seismic risk has an effect on every aspect and sector of social and economic life. It requires a combination of efforts and proficiencies from diverse sources. Therefore, an appropriate system design should unite these sources. In particular, more involvement from local disaster organizations is required to improve the performance of the disaster system.

In the next chapter, I will examine to what extent did the changes in informational infrastructure, and organizational structure improve the capacity of the Turkish disaster system in terms of component of socio-technical systems? The chapter will focus on changes to determine to what extent did the changes affect informational infrastructure, organizational flexibility, organizational culture, and local sustainability?

8.0 ADVANCEMENTS IN INFORMATION MANAGEMENT AND ORGANIZATIONAL CAPACITY AFTER THE 1999 EARTHQUAKES

8.1 INTRODUCTION

This chapter analyzes the improvements in organizational capacity and information processes capacity of the Turkish disaster system after the 1999 earthquakes. Data collected from the interviews were used to determine the level of improvement in informational infrastructure after the earthquakes, the current stage of local sustainability of the disaster system, and the degree of organizational changes to support organizational flexibility for disaster mitigation purposes. The analysis indicates to what extent the 1999 disasters had an impact on the understanding of Turkish public administration toward natural disasters, and shows improvements and gaps in the system.

The analysis in this chapter reveals the key insights in reference to the questions of the study:

What factors restrain or facilitate information processes among emergency organizations from different organizational and jurisdictional levels?

a. What internal and external factors create opportunities or deficiencies for better information exchange among organizations in the disaster management system?

b. To what extent do these initial conditions of the information infrastructure need to support the organizational structure in order to coordinate response to the disaster?
c. To what extent is it necessary for the organizational culture to support openness to new information?

How could advanced information systems be used to improve the performance of the disaster management system?

a. To what extent has the Turkish disaster management system become a socio-technical system?
b. What changes in the organizational structure of the Turkish disaster management system, if any, have been made after the earthquakes?
c. What changes in the technical information structure, if any, have been made at what governmental levels since the 1999 earthquakes?
d. To what extent are the developments in the information infrastructure after the earthquakes compliant with changes in the organizational structure?
e. What changes, if any, can help to create a better fit between Turkey's socio-technical infrastructure and the unpredictable and dynamic problem of seismic risk to which it is exposed?

8.2 CHANGES IN INFORMATIONAL CAPACITY OF THE DISASTER SYSTEM AFTER 1999 EARTHQUAKES

In this section of the study, I investigate the current stage of information infrastructure, investments in information technology, factors that facilitate or constrain the ability of agencies to utilize these tools, and willingness to engage in information sharing among organizations.

8.2.1 Advancement in Information Infrastructure

After the 1999 earthquakes, disaster organizations in Turkey realized the importance of information gathering and exchange for coordinated response during a catastrophic event. Table 44 presents data about the advancements in information and communication means after the disasters.

As shown in Table 44, the availability of information and communication technologies after the earthquakes has grown. It appears that most of the organizations, 19 of 36 respondents, or 16.1%, value cell/mobile phones for obtaining and exchanging the information. However, it is clear that there has been a greater focus on satellite phones (from 5 to 10) and wireless communication (from 8 to 18), since the 1999 earthquakes. The 1999 response operations proveindicated that satellite phones are more usable than cell and regular phones during a devastating earthquake.

The disaster organizations understand the importance of advanced information technology following the problems of the 1999 response operations. They began to invest in technologies by using local resources or obtaining financial and technical assistance from other agencies to establish a sufficient information capacity for their organization and the disaster system as whole. Nineteen of the 36 respondents, or 16.9%, said that they have been implementing GIS technology since the earthquakes while only seven of them had said they had GIS during the earthquakes. Most of the organizations attempting to implement GIS are the organizations with primary responsibility for response actions when a disaster occurs. Fifteen of the 39 respondents said that they are able to use GPS technology (*e.g.* only seven of them had GPS in the Marmara earthquake), and 5 of them said that their organizations have intelligent reasoning systems (*e.g.* only one of them had intelligent reasoning in the Marmara earthquake) for the purpose of disaster mitigation. Interestingly, eight organizations established a risk assessment model after the earthquakes, whereas none of the respondents said that they were able to use any sort of risk or damage assessment models during the 1999 earthquakes.

Table 44 Investments in Means of Information and Communication Technologies

"What kinds of advanced information and communication technologies has your organization adopted after the 1999 earthquakes?"		
Means of Communication	Responses	%
GIS	20[44]	16.9
GPS	15	12.7
Computer/Computer Networks	7	5.9
Satellite Phones	10	8.5
Radio/ Amateur radio	6	5.1
Internet	9	7.6
TV	0	0.0
Intelligent Reasoning	5	4.2
Advanced Wireless Communication	18	15.3
Cell / mobile Phones	19	16.1
Risk Assessment models	9	7.6
Other (n/a)	3	0.0
Total responses	118	100.0

N= Number of Responses; %= Percentage of Responses
Multiple responses were accepted.
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

[44] Nine of the projects were under development at the time of interviews.

However, the respondents pointed out that the system remains ill-prepared at the local level. Although the lack of information and communication technologies was one of the main causes of failure of coordinated inter-organizational disaster operations during the 1999 disasters, particularly during the Marmara earthquake, there are still many organizations, especially local organizations that do not have the capacity to adopt these technologies for disaster mitigation purposes.[45]

> "…We were at the center of the Marmara earthquake. The central government has done many things to improve technical capacity of the disaster organizations, but they did nothing here, in Golcuk. They made improvements in Ankara, or in Istanbul, or in other metropolitan cities. However, if an earthquake hit, we are the ones who have the responsibility to respond first. They gave me a brand new walky-talky and that is it. We still do not know that the local agencies come first."

As the Marmara response operations proved, insufficient information capacity of local organizations diminishes their participation in disaster affairs. Without involvement from the local disaster organizations, the system cannot perform successfully during a destructive disaster.

Twelve of 37 respondents, or 32.4%, continue to believe that their organizations are neither good nor bad in using information and communication technologies to improve coordinated actions for future disaster operations (Appendix D, Table 7). Seven, or 18.9%, claimed that their organizations are at a "less than good level" in terms of having sufficient information capacity to respond successfully to a destructive disaster. It is understandable that none of the respondents thinks that her organization has the ability to use information and communication systems at a great level, since they think that there is always more room to increase the information capacity of the system to a better level. Eighteen of the 37 respondents, or 48.6%, said that their organizations currently use these systems at a good level. When one

[45] Interview with Golcuk Crisis Management Center, June 16, 2004

considers that the research institutions tend to have a relatively good information infrastructure, it is clear that fewer disaster agencies that cope with the problems of disaster environments in practice possess sufficient information infrastructure capacity

The respondents listed some factors that influence their organizations' ability to utilize the information and communication means. Table 45 represents the factors that are important to organizations in the implementation and use of communication and information systems.

Table 45 Factors Affect the Utilization of Information Systems

"What are the most important factors in your organization's ability to utilize these tools? Please list them in accordance with significance?"

	1	%	2	%	3	%	4	%	5	%	6	%	Total Response	%
Trained Personnel	12	8.1	8	5.4	6	4.0	4	2.7	3	2.0	2	1.3	35	23.5
Financial Assistance	7	4.7	9	6.0	4	2.7	0	0	2	1.3	2	1.3	24	16.1
New Disaster Organizational Design	4	2.7	3	2.0	8	5.4	4	2.7	3	2.0	0	0	22	14.8
Constant Updated Data from Disaster Location	1	0.7	4	2.7	5	3.4	6	4.0	2	1.3	1	0.7	19	12.8
Changes in Laws/Regulations/Policy	8	5.4	4	2.7	10	6.7	7	4.7	1	0.7	0	0	30	20.1
Authority Deregulation	4	2.7	5	3.4	1	0.7	7	4.7	1	0.7	1	0.7	19	12.8
Other (n/a)	2												2	-
Total Response	36	24.2	33	22.1	34	22.8	28	18.8	12	8.1	6	4.0	149	100.0

N=Number of Respondents; %=Percentage of Respondents
Multiple responses were accepted.
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

According to the respondents, "trained personnel" (23.5%) and "changes in laws/regulation/policies" (20.1%) affect most directly their ability to utilize information and communication means adopted after the earthquakes. "Financial assistance" (16.1%), "new disaster organizational design" (14.8%), "constantly updated data from disaster location" (12.8%) and "authority deregulation" (12.8%) are other important factors, cited by them.

Twelve of the 36 respondents claimed that the lack of trained personnel is the greater constraint on their ability to use these tools more effectively.[46]

> "…We really need personnel even to do basic tasks. Central government does not really consider what we need. They assigned personnel without checking our needs. Some organizations have more personnel than they need. Some do not have even enough personnel to do paper work. We bought some technical equipment, but are waiting for personnel so that we could use them."

Eight of 36 respondents said that the disaster laws/regulation and policies need to be changed to permit more effective use of these tools.[47]

> "…The most important thing is disaster regulations. We can find the money. But the regulations do not give us authority to do things without permission from central government. The tasks of organizations are not clear. Ankara does not get our consultation. Some people in Ankara think they know everything, but they do not. They waste money."

Seven respondents rated financial assistance as the most important factor that affects their ability to use adopted information systems effectively.[48]

> "…We started to create a GIS database right after the Marmara earthquake. GIS could be useful if you update the data continuously. So, we needed a sort of department for this task. We had to hire technical personnel, new equipment, and so on. So, we needed extra financial sources. But, we had more important tasks to do after the earthquakes. We needed money for reconstruction of the city. Because of that we could not continue to keep GIS work."

8.2.2 Inter-organizational Knowledge Base after the 1999 Earthquakes

The analysis in chapter 5 has shown that the lack of inter-organizational knowledge base had a critical impact on the performance of coordinated operations. Therefore, it is necessary to

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[46] Interview with Yalova Crisis Management Center, June 17, 2004
[47] Interview with Sakarya Civil Defense Rescue Group, June 15, 2004
[48] Interview with Kocaeli Province Government, June 16, 2004

establish a shared knowledge base that allows disaster organizations to share disaster relevant information continuously.

Table 46 Investments in Inter-organizational Knowledge base after the Earthquakes

"Do you currently share any databases with other organizations?"		
	Response	%
Yes	7	17.9
No	32	82.1
Other (n/a)	0	0
Total Response	39	100.0

N=Number of Respondents; %=Percentage of Respondents
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Table 46 shows the availability of shared knowledge base. Although the lack of inter-organizational knowledge base created problems in exchanging necessary information among the disaster organizations during the earthquakes, the disaster organizations have not yet paid enough attention to this deficit. Only 7 of the 39 (17.9%) respondents said that their organizations currently have a knowledge base that they share with other organizations for the purposes of disaster affairs. According to the data presented, more than 80% of the disaster organizations are not able to use an inter-organizational knowledge base.

The existing knowledge base systems are mostly among provincial organizations. There is only one central organization that has a shared knowledge base with other organizations.[49] Two of the provincial organizations are metropolitan municipalities, Istanbul and Bursa Metropolitan Municipalities, whereas two of them are province governments, Istanbul and Bursa Government. Bogazici University and TUBITAK are the research institutions that share

[49] Interview with General Directorate of Disaster Affairs, Earthquake Research Center, June 10, 2004

knowledge bases with other organizations. Kizilay is the only nonprofit organization that has been working on a project to create a knowledge base to share with its local branches.[50]

These organizations essentially work together on major projects. Therefore it is reasonable for them to utilize a shared knowledge base. Organizations at the local level engage in disaster operations and institutions at the central level that have the authority (*e.g.* General Directorate of Turkey Emergency Management) and resources for disaster management have not yet participated in these information sharing activities.

8.2.3 Information Sharing for Disaster Mitigation

Information exchange during response operations in a destructive disaster depends on constant information sharing during normal times. This requires establishing various communication channels among the organizations and also promoting an organizational culture in which agencies are willing to share information. Table 47 presents the data regarding the exchange of disaster relevant information.

All of the respondents said that they currently have relationships with other organizations and exchange disaster relevant information. However, out of 37, only 9, or 24.3% of the respondents, who were mainly from search and rescue groups, said that they exchange disaster relevant information on a daily basis[51]. More than half of the respondents (21, or 56.8%) said that they sometimes exchange disaster relevant information. From the table, we can conclude that responsible disaster organizations need to exchange information more frequently.

[50] Interview with Kizilay Emergency Coordination Center, June 9, 2004
[51] 11 civil defense rescue groups were established in different regions of the country. These rescue groups are required to communicate two times everyday.

Table 47 Information Exchange Frequency

"How often do you exchange disaster relevant information with other disaster organizations (public, nonprofit, private)?"		
	Responses	%
Daily	9	24.3
Weekly	5	13.5
Monthly	2	5.4
Yearly	0	0
Sometimes	21	56.8
Not at all	0	0
Other (n/a)	2	0.0
Total responses	37	100.0

N=Number of Respondents; %=Percentage of Respondents
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

The lower level of information sharing results not only from insufficient information infrastructure capacity but also a lower degree of openness to new information in the organizational culture. Creating an organizational culture that promotes openness to new information is a huge task for disaster administration in Turkey. The experts from the Turkish disaster system acknowledge the fact that organizational culture in disaster organizations does not promote openness to new information to a high degree. Table 48 provides the data for the public, nonprofit and private disaster organizations in terms of their willingness to share information.

Out of 113 responses from 38 respondents, only 19.5% indicates that disaster organizations are willing to share the disaster relevant information to a high degree. The respondents that rated the willingness of information sharing among public, private and nonprofit organizations as high mainly consider information sharing to occur only during the disaster response and recovery phases.[52]

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[52] Interview with , Istanbul Province Crisis Management Center, June 21, 2004

"…When we ask information from any organizations, they tell us. We did not have any problems of getting information during the earthquakes. Everybody is very helpful. In fact, they legally have to share whatever they have."

Table 48 Willingness of Information Sharing

"How do you scale the organizations, public, private, non-profit, in terms of their willingness to share information?"								
	High	%	Medium	%	Low	%	Total Response	%
Public	9	8.0	11	9.7	18	15.9	38	33.6
Private	6	5.3	17	15.0	15	13.3	38	33.6
Nonprofit	7	6.2	21	18.6	9	8.0	37	32.8
Total Response	22	19.5	49	43.3	42	37.1	113	100.0

N=Number of Responses; %=Percentage of Responses
Multiple responses were accepted
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

When I rephrase my questions as "how about before an earthquake, during the normal time," they changed their response as follows:[53]

"…We have very bureaucratic difficulties in contacting especially public organizations. There is no organizational culture in Turkish public administration that supports information exchange. There is institutional patriotism among organizations. They are jealous of each other. They do not want others to be more successful than themselves. That is why they do not inform other organizations when they need specific information."

Table 36 shows that public organizations have both the highest (9, or 8%), and the lowest (18, or 15.9%) of responses regarding willingness to share information. This finding shows that there is no standard guideline or an organizational culture that promotes the sharing of

[53] Interview with , Middle East Technical University, Disaster Management Center, June 8, 2004

information among public organizations. The degree of willingness to share information depends mainly on the personnel who administer the organization.

As shown in Table 48, approximately 80% (medium + low) of the respondents asserted that disaster organizations are not willing to share disaster relevant information at a high level. Twenty one respondents claimed that it is relatively easier to get information from nonprofit organizations, whereas 17 of them made that claim for private organizations. Nonprofit and private organizations appear very similar to public organizations in their attitudes towards information sharing.

8.3 LOCAL SUSTAINABILITY

The success of any disaster system primarily relies on the sustainability of local communities where a disaster creates chaotic circumstances. The system should technically and institutionally establish sufficient capacity at the local level to quickly and effectively respond to a destructive event.

8.3.1 Primary Financial Sources

One of the primary requirements for building local disaster resilience communities is that local disaster organizations should have sufficient financial capacity to act more independently to adapt to dynamic disaster environments. Table 49 presents the data about the primary and secondary financial sources of interviewee organizations.

Table 49 Primary Sources of Funding

"What is your organization' primary source of funding?"								
	1	%	2	%	3	%	Total Response	%
Government (Central)	34	65.4	0	0.0	0	0.0	34	65.4
Donations	3	5.8	1	1.9	0	0.0	4	7.7
Private Sources	1	1.9	1	1.9	0	0.0	2	3.8
International Sources	0	0.0	2	3.8	2	3.8	4	7.7
Individual	0	0.0	5	9.6	3	5.8	8	15.4
Total Response	38	73.1	9	17.3	5	9.6	52	100.0

N=Number of Responses; %=Percentage of Responses
Multiple responses were accepted
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

As seen from Table 37, the Turkish disaster system relies financially on central government resources. According to Table 37, 34 of 38 respondents said that the main source of funding for their organizations is the central government. There are only three organizations that report their primary sources to be donations. Only one organization relies on primarily private financial sources. This analysis indicates that there is a significant financial dependency on central government. This situation tends to reinforce the centralized disaster system.

8.3.2 Information Gathering

Local disaster organizations should maintain open communication channels with other agencies at different organizational and jurisdictional levels to gather accurate disaster relevant information upon which to base their decisions. Close connections with central and provincial organizations to enable the collection of disaster relevant information is very important for establishing a local sustainable community. Table 50 presents responses regarding the ability of disaster organizations to gather disaster relevant information.

Table 50 Information Gathering

"To what extent do you feel that you have all necessary information for emergency management purposes?"		
	Response	%
Great extent	0	0
Good extent	17	44.7
Neither good or bad	15	39.5
Less than good	6	15.8
Not at all good	0	0.0
Other: (n/a)	1	0.0
Total response	38	100.0

N=Number of Responses; %=Percentage of Responses
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

According to Table 50, 17 of the 37 interviewees, or 44.7%, have all necessary information for emergency management purposes to a good extent. However, they claimed that others were not as fortunate.[54]

> "…I know what to do because I have been in disaster management for many years. I have joined the response operations since the 60's. I have been working in emergency management more than three decades. So, I know where and what kind of information I need to gather. But not everybody is as lucky as I am to know all necessary information."

More than half of the respondents (55.3%) do not think that they have all necessary information to a good extent. The respondents claimed that obtaining disaster relevant information, especially from central organizations, is very difficult (see Table 51). None of the respondents claimed that information acquisition from disaster organizations is very easy. Eighteen of the 38 respondents, or 47.4%, think information gathering is difficult. Fourteen or 36.8% of the respondents said that information acquisition from disaster organizations is neither good nor bad. As shown in Table 51, only 6 out of 38 respondents, or 15.8%, claim that it is easy for them to obtain and disseminate disaster relevant information. These respondents state that

[54] Interview with Turkish Red Crescent Society, June 9, 2004

they are able to obtain disaster relevant information by using their personal friendships and good connections with responsible managers in other disaster organizations.[55]

> "…Personally, I have no difficulties in getting information from other public organizations. I have been working for 20 years in disaster affairs. I know most of the responsible managers in other public organizations. If I need anything, I directly call them. I do not go through standard procedure. If I do not use my connections, it is so difficult to obtain information from them."

Table 51 Difficulties in Information Gathering

"To what extent do you have difficulties in obtaining information from other local, provincial, central disaster organizations –public, private and nonprofit-?"		
	Response	%
Very difficult	2	5.3
Difficult	16	42.1
Neither good nor bad	14	36.8
Easy	6	15.8
Very easy	0	0.0
Other: (n/a)	1	0.0
Total response	38	100.0

N=Number of Responses; %=Percentage of Responses
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Bureaucratic organizational structure and organizational culture are impediments to the capacity of disaster agencies to obtain, and share disaster relevant information with other organizations. Disaster organizations tend to keep important information for themselves and in most cases they are not willing to share it.[56]

> "…You have to do lots of procedures to get basic information. For instance, the law says that land registry and cadastral information should be open to public. If anybody even a common citizen asks to get this information, the public organization is required to provide this information. However, in practice, it is almost impossible to get this information not just for a citizen but also for an organization like us."

[55] Interview with Communication and Logistic Department, GDDA, July 10, 2004
[56] Interview with Sakarya Civil Defense Rescue Group, June 15, 2004

8.3.3 Capacity for Independent Actions

The self-governing capacity of disaster organizations to take independent action is an important indication of local sustainability. Self-governing disaster organizations should have flexibility to act based on accurate and timely information for disaster mitigation. In order to have this flexibility, disaster organizations should possess sufficient financial and technical capacity, skilled personnel, appropriate disaster regulations and political environment that permit independent action. These factors also affect the ability of organizations to build appropriate information infrastructure for information gathering and exchange. As seen in Table 52 the respondents categorized these primary factors in terms of importance to their organizations.

Table 52 Factors Constrain Independency

"What do you believe are the most important factors that constrain your ability to take independent actions? Please list them in terms of importance to you?"

Factors	1	%	2	%	3	%	4	%	5	%	Total Response	%
Financial	4	2.8	11	7.6	7	4.9	3	2.1	3	2.1	28	19.4
Insufficient equipment	0	-	2	1.4	10	6.9	9	6.25	7	4.9	28	19.4
Trained personnel	6	4.2	6	4.2	11	7.6	6	4.2	1	0.7	30	20.8
Laws/regulations	22	15.3	6	4.2	1	0.7	2	1.4	2	1.4	33	22.9
Political environment	4	2.8	7	4.9	4	2.8	4	2.8	6	4.2	25	17.4
Other (n/a)	2											
Total Responses	37	25.0	32	22.2	33	22.9	24	16.7	19	13.2	144	100.0

N=Number of Responses; %=Percentage of Percentages
Multiple responses were accepted
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

According to the respondents, current "laws and regulations" (33 of 144 responses, or 22.9%) are the main factors that constrain the ability of disaster organizations to take independent actions. The lack of "trained personnel" (20.8%); (3) insufficient "financial capacity" (19.4%); (4) "insufficient equipment" (19.4%); and (5) "political environment" (17.4%) fall below "laws and regulations".

Twenty-two of 33 respondents asserted that current laws and regulations are the most crucial issue constraining the ability of their organizations to take independent actions, whereas six of them believed that current laws and regulations are secondary issues.

Six out of 30 respondents who underline the importance of trained personnel claimed that the lack of "trained personnel" is the main factor, whereas 11 of them stated that "trained personnel" has a third degree of importance in terms of affecting their self-governing ability. Four of 28 respondents who stated that insufficient financial capacity is important claimed that insufficient "financial capacity" is the most important, whereas 11 of them said that it is the second important factor that hinders their ability for independent actions.

Although 19.4% of respondents cited the lack of "sufficient equipment", none of the respondents claimed that this factor had a first degree of importance. Among 25 respondents who stated that political environment is important, four of them claimed that "political environment" is the most important issue that constrains their organizations in performing as flexibly as they need.

When we consider the centralized and bureaucratic characteristics of the Turkish disaster system, it was not surprising that the primary factor that restrains the ability of organizations to take independent actions is "laws and regulations". The data show that the organizations request appropriate disaster regulations, qualified personnel, and more financial sources to develop more self-operating disaster organizations.

Based on these criteria, the question "To what extent do you have the capacity to implement and change disaster policies or reallocate resources?" was asked. According to the data presented in Table 8 (see Appendix D), only one of 35 respondents, or 2.9%, claimed that her organization has a great capacity to change and implement the disaster policies and reallocate resources.[57] When we add the number of respondents who claimed that their organizations have a "good capacity" to change and implement the disaster policies and reallocate resources, the total number grows to 5, which represents only 14.3% of the respondents. Fourteen of 35 respondents, or 42.9%, claimed that their organizations have "less than good" or "not at all good" capacity to change and implement the disaster policies and reallocate resources.

8.4 ORGANIZATIONAL CHANGE AND DISASTER MITIGATION

This part of chapter analyzes the data that indicate the form and purposes of changes that have been initiated since the earthquakes. Following the 1999 earthquakes, disaster organizations instituted changes to better cope with disasters. The purpose of changes in organizational and technical aspects of the agencies should normally be consistent with the practical problems that were observed during the 1999 disaster response operations. Therefore, the analysis in this section inspect to what extent did the changes improve organizational flexibility?

8.4.1 Organizational and Technical Change

There are six major issues that the Turkish disaster system considers essential to address in order to create a better disaster system. They are: (1) "Changes in laws and regulations"; (2) "changes

[57] Only General Command of Mapping claimed they have sufficient sources and authority to act independently.

in organizational structure”; (3) “changes in financial conditions”; (4) “changes in personnel”; (5) “changes in technical capacity”; and (6) “changes in information infrastructure”. Table 53 presents the data that categorize the changes accomplished by disaster organizations after the 1999 earthquakes.

Table 53 Organizational and Technical Changes

“What sorts of significant changes have there been in your organization for the purposes of disaster management? Please list them in terms of importance to your daily operations?”

Changes	1	%	2	%	3	%	4	%	5	%	6		Total Response	%
Changes in laws/regulations	0	0.0	0	0.0	1	0.7	2	1.5	1	0.7	1	0.7	5	3.7
Changes in organizational structure	11	8.1	6	4.4	2	1.5	6	4.4	0	0.0	0	0.0	25	18.5
Changes in financial conditions	2	1.5	0	0.0	1	0.7	3	2.2	4	3.0	1	0.7	11	8.1
Changes in personnel	3	2.2	7	5.2	9	6.7	10	7.4	0	0.0	0	0.0	29	21.5
Changes in technical capacity	13	9.6	12	8.9	7	5.2	1	0.7	0	0.0	0	0.0	33	24.4
Investments in information infrastructure	7	5.2	10	7.4	14	10.4	1	0.7	0	0.0	0	0.0	32	23.7
Other (n/a)	3													
Total Response	36	26.7	35	25.9	34	25.2	23	17.0	5	3.7	2	1.5	135	100.0

N=Number of Responses; %=Percentage of Responses
Multiple responses were accepted
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

The responsible managers were somewhat able to improve the organizational and technical capacity of their organizations. Investment in technical capacity and information infrastructure became top priorities after the 1999 disasters. According to the table, public managers paid more attention to increasing the technical capacity of organizations (24.4%) and invested in information infrastructure (23.7%). Among all 135 responses, 13, or 9.6%, of them stated that the organizations put more emphasis on increasing technical capacity than any other issue. Seven, or 5.2%, of responses claimed that “investment in information infrastructure” was the first priority of their organizations after the 1999 earthquakes.

Changes in personnel capacity (21.5%), changes in organizational structure (18.7%), and changes in financial conditions (8.1%) follow respectively. Although “changes in organizational structure” overall falls below “investment in information infrastructure” and “changes in personnel capacity,” more respondents claimed that their organizations put more effort on “changing organizational structure” (11, or 8.1%) as a first priority. Only three, or 2.2% and two, or 1.5% of respondents claimed that “increasing personnel capacity” and “improving financial conditions,” respectively, are the most important issues that their organizations attempted to develop. Only 11 of 36 respondents believed that changes in financial conditions are significant to their organizations.

Although the respondents asserted that current Turkish disaster policies are the most important factors that constrain their ability to take independent actions (see Table 40), the disaster system was unable to put more emphasis on changing laws and regulations. Only five out of 36 respondents believed that there have been some important changes in “disaster laws and regulations”. According to these respondents, these changes were at most the third degree of significance to their organizations.[58]

> “…Laws and regulations need to be changed. There are a lot of authority confusions. The people in Ankara do not want to lose their power. Local institutions can not do much, as long as the bureaucratic, centralized system prevails. Everybody says something. Municipalities, provincial and district governments, and central government have different ideas and authority for

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[58] Interview with Bole Province Government, June 14, 2004

> disaster affairs. We need to make tasks clear. Everybody should clearly know what to do. I am not saying more rules. I am saying clear and straight rules. In fact we need a new public administration, not just new disaster administration."

Even though the respondents acclaimed the importance of reforms after the earthquakes, the analysis indicates that the responsible managers have been struggling to change the conditions that are most problematic to their organizations. As one respondent points out, the disaster organizations need more improvements to significantly increase the organizational and technical capacity of the system.[59]

> "…Do not get me wrong. We have done many things, especially right after the earthquakes. First 2-3 years. But we need a lot. We compare ourselves before earthquakes. Yes, we improved. But this is just the beginning. We bought devices, vehicles, established new institutions and we started some projects and everything. But, we have lots of things to do. Unfortunately, I feel that we are slowing down."

8.4.2 The Purposes of Changes

The changes in technical and organizational aspects of the disaster system implemented after the 1999 earthquakes cover three main phases of disaster mitigation. The success of these changes and eventually the success of the disaster system depend on the degree of improvement in the phases of preparedness.

From Table 54, we can see that the primary purpose of the changes is for the stage of immediate response after an earthquake hits. Twenty of 37 respondents, or 54.1%, said that the main purpose of the changes is to improve the disaster system's response capacity. Correspondingly, 20, or 54.1% of the respondents stated that the secondary aim of these changes is intended to develop the capacity of the disaster system for recovery and relief operations. If we

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[59] Interview with Turkish Red Crescent Society, June 10, 2004

sum the first two columns of the sections "response" (54.1%+32.4%) and "recovery and relief" (8.1%+54.1%), we can clearly observe that the first and second purposes of the changes in technical and organizational capacity focus on the tasks that have to be performed after a disaster occurs. Most of the respondents acknowledged that the rescue capacity of the Turkish disaster system has developed significantly since the 1999 earthquakes.[60]

> "...We really have professional rescue groups, now. We significantly improved that. I can easily say that Turkey, now, is one of the best countries in terms of skilled rescue and response teams. Most of the organizations bought advanced technical equipment, advanced communication devices and hired and trained new personnel. Many volunteer organizations were also established."

Table 54 The purposes of changes

"For what purposes have these changes been primarily carried out? Please order by priority given by your organization?"								
	1	%	2	%	3	%	Total Response	%
Preparedness	14	37.8	5	13.5	18	48.6	37	100.0
Response	20	54.1	12	32.4	5	13.5	37	100.0
Recovery/Relief	3	8.1	20	54.1	14	37.8	37	100.0
Other (n/a)	2							
Total Response	37	100.0	37	100.0	37	100.0	111	100.0

N=Number of Responses; %=Percentage of Responses
Multiple responses were accepted
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

In contrast, 14 of 37 respondents, or 37.8%, claimed that their efforts mainly focused on the first stage of the disaster mitigation cycle, preparedness before a disaster. Approximately half of the respondents (48.6%) said that "the preparation before an earthquake" is the last purpose of

[60] Interview with Avcilar Crisis Management Center, June 22, 2004

the changes. Accordingly, there remains a large gap in the stage of disaster preparedness especially for metropolitan cities. One interviewee emphasized:[61]

> "…We are still very fragile to any earthquake in metropolitan cities. We have focused on rescue and recovery stages so far. We are so slow to do things that will minimize seismic risk. We pay more attention to emergency management than risk management."

8.4.3 Organizational Flexibility

It is necessary to determine to what extent these changes in technical capacity and organizational design affect the organizational flexibility of the disaster management system. Organizational flexibility is a vital issue for a self-governing disaster system. Disaster organizations should be flexible to act quickly and adapt to new complex conditions that a disaster creates. Appropriate policies and regulations as well as technical and organizational structure are necessary for increasing organizational flexibility. Table 55 provides information which indicates the effectiveness of the changes to organizational flexibility.

Experts in the Turkish disaster system believe that increases in organizational flexibility after the reforms are not significant. According to Table 55, only 10.8% of respondents acknowledged that the changes have significantly increased the organizational flexibility. Approximately half of the respondents (48.6%) acknowledged that the changes in technical capacity and organizational design after the earthquakes somewhat increased the organizational flexibility.

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[61] Interview with Kocaeli Fire Department, June 16, 2004

However, 15 out of 37 respondents, or 40.6%, claimed that there is no significant increase in the organizational flexibility of the disaster system. The changes in technical and organizational aspects of the Turkish disaster system will be beneficial only if they create a flexible disaster system. One expert noted this fact.[62]

> "…If information is the first important thing in disaster administration, flexible organizational structure is the second. Unfortunately, we still have very strict disaster system. In fact this is the problem of Turkish public administration. The disaster system is a part of whole system. Without changing the whole public administration structure, how should we change the disaster system? The system is still very inflexible, and very bureaucratic. It usually depends on individuals. If the person understands the issue, you can be more flexible to do things. Otherwise, you should be careful. You could have many problems with central government."

Table 55 Changes in Organizational Flexibility

"To what extent have those changes in technical capacity and organizational design since the earthquakes increased/decreased the organizational flexibility of the disaster management system?"		
	Responses	%
Increased significantly	4	10.8
Increased somewhat	18	48.6
No change	15	40.5
Decreased somewhat	0	0.0
Decreased significantly	0	0.0
Other (n/a)	2	-
Total Responses	37	100.0

N=Number of Responses; %=Percentage of Responses
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

[62] Interview with Sakarya Civil Defense Group, June 15, 2004

8.5 TOWARD A MORE EFFECTIVE TURKISH DISASTER SYSTEM

The tasks must be implemented by the Turkish public administration are quite wide ranging, from educating Turkish citizens to training the emergency personnel. The respondent organizations highlighted important responsibilities of the administration from their point of view. I categorized these recommendations and Table 56 presents this analysis.

Of 39 interviewees, 38 of them provided 215 multiple responses to the question "What do you recommend to significantly increase the effectiveness of Turkish disaster management system?" According to Table 56, "increasing enforcement for construction facilities" is seen as the most important factor to decrease the vulnerability of the Turkish disaster management to destructive earthquakes (36; 16.7%). Considering the challenge of illegal construction activities in seismic risk prone areas, it is very reasonable that the experts consider this issue as the main concern of the system.

An interesting point is that the experts consider information infrastructure as the second most critical issue to which Turkish public administration should pay more attention and develop for a more effective disaster system. Thirty one respondents believe that more investment in information and communication systems will assist coordination of efforts in every phases of disaster mitigation. "Investments in information infrastructure" (31, or 14.4%) are seen as important as "educating citizens" about disaster affairs (31, or 14.4%).

"Increasing power of local public organizations" (29, or 13.5%) and "increasing trained personnel" (29, or 13.5%) follow the first three factors. "Changing laws and regulations" (21, or 9.8%), "establishing new organizational design" (13, or 6.0%), "changing building codes" (11, or 5.1%) are other essential reforms that the respondents recommended for a better disaster system.

Table 56 Recommendations for more Effective Turkish Disaster System

"What would you recommend to significantly increase the effectiveness of Turkish disaster management system? Please list them in accordance with importance to yo?"

Recommendations	1	%	2	%	3	%	4	%	5	%	6	%	7	%	Tot Response	%
More investments in information infrastructure	3	1.4	3	1.4	2	0.9	7	3.2	4	1.9	7	3.2	5	2.3	31	14.4
Increasing power of local public organizations	2	0.9	1	0.5	6	2.8	5	2.3	8	3.7	6	2.8	1	0.5	29	13.5
Increasing number of trained personnel	1	0.5	3	1.4	3	1.4	5	2.3	11	5.1	3	1.4	3	1.4	29	13.5
Establishing new emergency organizational design	1	0.5	3	1.4	1	0.5	1	0.5	3	1.4	2	0.9	2	0.9	13	6.0
Educating citizens	3	1.4	9	4.2	11	5.1	5	2.3	2	0.9	1	0.5	0	0.0	31	14.4
Changing building codes	0	0.0	1	0.5	1	0.5	4	1.9	3	1.4	1	0.5	1	0.5	11	5.1
Increasing enforcement for construction facilities	8	3.7	5	2.3	12	5.6	8	3.7	1	0.5	2	0.9	0	0.0	36	16.7
Changing laws/ regulations (more clear about the tasks of EO)	13	6.0	7	3.2	0	0.0	1	0.5	0	0.0	0	0.0	0	0.0	21	9.8
The conception of emergency management should change	3	1.4	4	1.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	7	3.3
Coordination of efforts of EO	2	0.9	1	0.5	1	0.5	1	0.5	0	0.0	0	0.0	0	0.0	5	2.3
Developing economic conditions	2	0.9	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	0	0.0	2	0.9
Other (n/a)	1														1	0.0
Total Responses	38	17.6	37	17.1	37	17.1	37	17.1	32	14.8	22	10.2	12	5.6	215	100

N=Number of responses; %=Percentage of Responses
Multiple responses were accepted
Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

“Changing disaster laws and regulations” has a total number of 21 responses, and overall, it is the fifth most important factor. However, thirteen of the 21 respondents claimed that changing current disaster laws and regulations should be the first priority of Turkish public administration. The majority of respondents do not consider the current disaster laws and regulations sufficient to manage the seismic risk that Turkey faces. The respondents repeatedly insisted that the disaster laws and regulations are the most important factors that constrain their ability to take independent actions and create a flexible and sustainable disaster system.

Eight of 36 respondents think that “increasing enforcement for construction facilities” is the most important issue for the administration although there are only 11 respondents who claim that building codes need to be changed. None of these respondents claim that changing building codes is the most important priority for Turkish public administration. The respondents mainly assert that building codes are only meaningful if the officials strongly enforce their implementation.

Another fundamental requirement reported by the respondents is “more investment on information infrastructure”. It is notable that the respondents consider this issue to be one of the most important to the operation of the disaster system. Of 38 respondents, 31 of them believe that the system should invest more in information and communication systems for a better disaster management. Seven of 31 respondents see this issue as being of fourth importance. Three of 31 respondents believe it is the most important issue. The difficulties generated by uncoordinated operations during the 1999 earthquakes proved how vital timely and accurate information is for coordination of response operations. Therefore, the responsible managers call attention to this fact and recommend allocating more resources to it.

8.6 SUMMARY

In this chapter, I analyzed the data gathered from interviews of experienced personnel in the Turkish disaster management system to assess the improvements in the system after the 1999 earthquakes. Based on my theoretical model, I analyzed the data from three points of view: (1) improvements in information infrastructure, (2) improvements in local sustainability, and (3) improvements in organizational flexibility and disaster mitigation.

The analyses indicated that disaster organizations attempted to establish basic information and communication means to improve information capacity of the system. However, deficiencies remain despite the efforts. First, information infrastructure in local agencies is very weak. Second, the lack of necessary inter-organizational knowledge base among the disaster agencies has yet to be adequately addressed. Third, organizational culture, particularly in public disaster agencies, does not support information sharing among disaster organizations.

In the last part of the chapter, I categorized experts' recommendations for creating a better disaster system. The respondents believe that regardless of the efforts initiated after the 1999 earthquakes, Turkey does not have sufficient organizational and technical capacity to manage a destructive future earthquake. The most important tasks that the system has to carry out are listed as "changing disaster laws and regulations," "increasing enforcement for construction facilities," "educating citizens," and "more investment on information infrastructure".

9.0 IMPLICATIONS AND CHALLENGES FOR A SOCIO-TECHNICAL TURKISH DISASTER SYSTEM

9.1 INTRODUCTION

This chapter summarizes and reviews the findings from the research to explore implications and challenges for Turkish disaster administration. The findings point to the course of actions required to create a socio-technical Turkish disaster system better able to cope with seismic risk in Turkey. In the first part of this chapter, I discuss the initial conditions of the existing information infrastructure to determine the questions of how effectively the information infrastructure capacity of the Turkish Disaster Management System supported the organizational response operations in the 1999 Marmara and Duzce Earthquakes. Then, I assess the findings to define factors that restrain or facilitate information processes among emergency agencies from different organizational and jurisdictional levels. Finally, I evaluate the changes made after the earthquakes to determine how advanced information systems can be utilized to improve the performance of the disaster management system. In the last part of the chapter, I address the challenges from management, policy and organizational perspectives, and propose policy suggestions for the Turkish public administration to establish a socio-technical Turkish disaster system. I evaluate the findings from practical and theoretical perspectives.

9.2 INITIAL CONDITIONS OF INFORMATION INFRASTRUCTURE

The initial conditions of the information infrastructure during the 1999 Marmara and Duzce response operations determined the performance of disaster organizations. The research found that utilization of information and communication means, availability of a shared knowledge base, and the information exchange capacity of the disaster system hindered or facilitated information search, acquisition and exchange to support coordinated operations.

Research Question 1:

- How effectively did the existing information infrastructure capacity of the Turkish Disaster Management System support the organizational response operations in the 1999 Marmara and Duzce Earthquakes?

Difficulties in obtaining and exchanging timely and accurate disaster relevant information inhibited successful performance of disaster organizations during the Marmara response operations. The lack of necessary information and communication infrastructure constrained a coordinated response to the earthquakes. However, the Turkish disaster management system was more adaptive and relatively more successful in responding to the Duzce earthquake. The individual and organizational experiences from the Marmara earthquake taught responsible managers that information search, acquisition and exchange are vital for effective coordinated response operations. Therefore, a better understanding of the importance of disaster relevant information generated faster and more coordinated response operations.

Research Proposition:

- The socio-technical characteristics of a disaster management system need to match the dynamic and uncertain characteristics of disaster environments. The initial conditions of the organizational and informational capacity of a disaster system determine the performance of response and recovery operations.

Although means of communication and information, and the existence of an inter-organizational knowledge base did not significantly differ from the Marmara to the Duzce earthquake, utilization of information and communication systems was improved. Information exchange was faster and more effective in providing timely and accurate disaster relevant information, which resulted in better coordinated response operations during the Duzce earthquake and more involvement from local organizations. The inclusion of local organizations in the improved disaster response permitted faster, more appropriate assistance to needy communities.

9.3 FACTORS THAT RESTRAIN OR FACILITATE INTERGOVERNMENTAL COORDINATION

In addition to a sufficient information infrastructure, organizational flexibility and organizational culture are other important factors that hinder or facilitate information processing among disaster organizations during both regular and emergency periods. The informational capacity of a disaster system is effective if the system is flexible to adapt to changes in the disaster environment and promotes an organizational culture that allows openness to new information.

Research Question 2:

- What factors restrain or facilitate information processes among emergency organizations from different organizational and jurisdictional levels?

Research Proposition:

- A disaster response system possesses dynamic, unpredictable, and complex characteristics. The complexity arises from numerous interactions among components within the organizational system and their environment. The success of the system depends on the level of connectedness of the parts and the adaptability of the whole system to changing conditions in the environment in which the system operates.

Organizational flexibility is vital in increasing or decreasing performance of a socio-technical disaster system. According to the data gathered from respondent disaster organizations, the Turkish disaster system is not flexible enough to adapt rapidly to the changes in disaster environments. The analysis showed that changes in technical, organizational structure, and disaster policies after the 1999 earthquakes somewhat increased organizational flexibility. However responsible managers from disaster organizations argue that the disaster system does not yet have sufficient flexibility to overcome dynamic, complex problems of seismic risk. Disaster laws and policies, trained personnel, financial sources, insufficient equipment, and political environment are key factors affecting the self-governing ability of disaster organizations. A flexible disaster system with sustainable local disaster sub-systems is more effective to deal with destructive earthquakes.

Organizational culture is an important aspect of self-governing and flexible socio-technical systems. The analyses indicated that the organizational culture of Turkish disaster agencies does not promote an environment in which people are open to sharing disaster relevant information. The respondents interviewed claimed that public organizations in particular, are least engaged in information sharing. Nonprofit and private organizations are also not much different. The responsible managers use their personal relationships to obtain and transmit information. More than half of the disaster organizations interviewed believe that they do not posses necessary disaster relevant information because organizations tend to withhold and are not willing to share it.

Research Proposition:

- Disasters create turbulent and complex conditions that require valid and timely information. Therefore, a disaster management system needs to have sufficient flexibility through decentralization and lateral coordination for information search, exchange and organizational learning.

The analyses showed that the Turkish disaster policy and structure are based upon linear assumptions that produce a centralized and bureaucratic disaster system. The findings present a disaster system that functions mainly at the central level.

According to the UCINET network analyses (Borgatti, Everett, Freeman, 2002) and N-K analysis, the response systems were mainly operated by central, international and provincial organizations and there was insufficient involvement of local organizations, especially in the Marmara response operations. Public-district organizations played a very small role in the response operations. There was also insufficient involvement of municipalities in both response systems. The local actors were unable to communicate with other actors from different jurisdictions due to the problems in obtaining accurate and timely information. The analysis proved that increasing communication and coordination activities increased involvement of local organizations during the Duzce response operations.

The findings demonstrate that the Turkish disaster response system is also very weak in terms of participation from nonprofit organizations. The Turkish Red Crescent Society, the only nonprofit organization in the formal Turkish disaster system that functioned as the major nonprofit agency in both response systems. The Turkish Amateur Radio Club and AKUT were other nonprofit organizations that played very significant roles in rescue operations and in establishing communication channels among responsible managers from different organizations.

Lastly, international assistance appears to be very valuable component for an effective Turkish disaster management system. International organizations were significantly involved in both response systems. Although the formal Turkish disaster structure does not take international involvement into consideration, in practice it is a very critical part of the system since national and local resources are not sufficient to overcome the problems generated by a destructive earthquake.

9.4 INCREASING INFORMATIONAL AND ORGANIZATIONAL CAPACITY OF THE DISASTER SYSTEM

The consequences of uncoordinated response operations during the 1999 earthquakes, especially in the Marmara earthquake awakened the Turkish public administration. After the disasters, the Turkish public administration began to reform the organizational and informational infrastructure to strengthen the response capacity of disaster agencies. Disaster organizations from different jurisdictions and sectors, individually and jointly, initiated significant projects. The goals and characteristics of these attempts provide valuable insight about improvements and the gaps in the disaster system.

Research Question 3:

- How could advanced information systems be used to improve the performance of the disaster management system?

Research Proposition:

- Sufficient and timely information processing requires using necessary information infrastructure. Increasing information capacity through information infrastructure increases information search, exchange, and feedback within a system, and between the system and its environment.

Based upon the analyses, it is clear that the Turkish disaster system recognizes the importance of information and communication for effective disaster management. There have been notable efforts to advance information capacity of the system. Many organizations established basic communication tools and made considerable investment in advanced information systems. Disaster organizations joined in many projects to develop a system that continuously monitors and records seismic activity. National and international research institutions, notably Bogazici University, Kandilli Observatory, Istanbul Metropolitan University, the Scientific and Technical Council of Turkey, General Directorate of Disaster Affairs Earthquake Research Department, Istanbul Technical University, and Middle East Technical University participated in important projects to predict future earthquakes and prepare strategic plans for disaster operations.

The research indicated that public-central organizations have been the primary source behind attempts to the adoption of information systems. Local disaster agencies rely upon central government sources and lack the resources to develop their own capacity. While central disaster organizations and some province governments (i.e. Bursa Province Government) and municipalities (e.g. Istanbul Metropolitan Municipality) participate significantly in projects to improve their information management capacity, many local disaster organizations (e.g. Golcuk District Government) lack basic communication tools.

A considerable number of disaster organizations adopted advanced information and communication systems such as Geographic Information Systems and Wireless Communication Networks to obtain, assess and exchange disaster relevant information. However, simply investing in these systems is not enough to establish an information structure among disaster organizations. The research found that there are several factors that significantly affect organizations' ability to utilize these tools. According to the respondents included in the sample, one of the most critical problems is the "lack of trained personnel". "Strict disaster laws and regulations", "inadequate financial sources", "authority deregulation", and "lack of constantly updated data" from disaster locations are other factors that hinder the effective utilization of existing information infrastructure.

Finally, the research discloses that establishing an inter-organizational knowledge base is a key factor to exchanging timely and accurate information for coordination of disaster activities. However, the lack of a necessary inter-organizational knowledge base among the disaster agencies remains an insufficiency yet to be addressed.

Research Proposition:

- Improving organizational capacity and information processes for local disaster organizations increases information flow and enables responsible decision makers from different jurisdictions to make timely and effective decisions. Timely and effective decisions based on continual organizational interactions increase coordination between organizations. Thus, well-coordinated operations will save more lives and reduce the cost of disasters to communities.

Although the attempts after the 1999 earthquakes are considered a positive step, deficiencies remain in terms of strengthening the information infrastructure of local disaster organizations. The local agencies are not sufficiently integrated into the process of improving the disaster management system. For instance, public-district organizations play a very small role in this progress. The local disaster agencies lack sufficient financial, technical, and personnel capacity to undertake necessary tasks and independent actions. The analyses revealed that the most fundamental impediment that constrains the ability of local agencies to deal with disaster issues is the restrictive nature of disaster laws and regulations.

Further, there is not sufficient involvement from municipalities in the projects. Municipalities are not very active in disaster affairs, although they have more authority over land development policies. The only exception is the Istanbul Metropolitan Municipality. Because of its immense financial resources, Istanbul Metropolitan Municipality is highly involved and supportive of initiations that seek to strengthen the organizational and technical capacity of the Turkish disaster system.

Finally, the research found that improvements in the disaster management system after the earthquakes focused mainly on later phases of disaster management. The system is improved for response and recovery operations; however, it has not yet adequately prepared for disaster mitigation.

9.5 CHALLENGES AND RECOMMENDATIONS

9.5.1 Challenges from Management Perspectives

The analyses of the response system showed that the centralized and bureaucratic Turkish disaster system failed to meet the needs of uncertain and dynamic disaster environments. Although the responsible managers recognized this, and complained about restrictive disaster laws and regulations, the post-earthquake reforms have not altered the centralized characteristics of the Turkish disaster system. Since authority and resources are accumulated by central organizations, local organizations are unable to take independent action to transform their performance based on the changing parameters in disaster environments. Turkish public administration must create a management structure that diminishes the centralized effect of the disaster management system.

According to disaster laws and regulations, province and district disaster organizations are initially responsible for response to an earthquake. However, in practice, local organizations do not possess the operational and technical capacity to manage the consequences of a moderate or destructive earthquake. Central level organizations usually command and control disaster operations. This system creates confusion and constrains the ability of disaster agencies to respond quickly when timely action is crucial. In this respect, establishing a sustainable local disaster system should be the first priority of the Turkish disaster management. Local organizations should be supported by financial resources, trained personnel and advanced information and communication means to establish a sustainable local disaster system.

The 1999 response operations and joint projects initiated after the earthquakes proved that outside assistance from different jurisdictional levels and sectors is very vital. International organizations played very instrumental roles in both response systems and supported the attempts to establish a new disaster system in Turkey. The Turkish disaster management system should consider these efforts and develop appropriate policies to coordinate this type of assistance in advance of the next disaster.

The findings also indicated that involvement of nonprofit organizations in disaster affairs is vital. For example, AKUT and TRAC played major roles during the response operations and participated in efforts to increase the communication and rescue capacity of the system. After the earthquakes, many communities created local rescue groups. However, the formal Turkish disaster management structure includes only one nonprofit organization, Turkish Red Crescent

Society. Thus, the system should create an appropriate structure that connects nonprofit organizations to it.

Multi-jurisdictional disaster organizations have caused coordination difficulties before, during and after disasters. The Turkish public administration observed this problem and established an agency, the General Directorate of Turkey Emergency Management. GDTEM that is responsible for coordination of disaster affairs during both emergency and non-emergency periods. However, organizations such as the General Directorate of Civil Defense or the General Directorate of Disaster Affairs have similar responsibilities. After a disaster occurs other organizations such as the Prime Ministry Crisis Management Center and the Natural Disaster Coordination Committee are fully or partially responsible for coordination of disaster operations as well. The confusion brought about by conflicting authorities among the coordination agency makes coordination of disaster operations more problematic. The establishment of GDTEM is not able to address this issue since the organizations are at the same hierarchical level, and GDTEM does not have any authority over other coordination agencies. Many of the Turkish disaster experts interviewed suggested that the establishment of GDTEM eliminated the need for PMCMC. Instead, the administration should reform GDTEM as the Prime Ministry Emergency Management Undersecretariat, with authority over other coordination agencies.

9.5.2 Challenges from Policy Perspectives

The research findings suggest that changes should be made in Turkish disaster policies. First, the two primary disaster policies, Disaster Law 7269 and Regulation 12777 should be amended to reflect the new conditions of seismic risk in Turkey. Disaster policies were prepared decades ago and based on linear and bureaucratic assumptions of public administration. However, changes in the demographic, social, and economic characteristics of the nation made seismic risk more hazardous for Turkish people. Turkish public administration should reform disaster policies based on the new circumstances of risk prone areas.

Second, the disaster management system should place greater emphasis on mitigation efforts rather than simply improving the rescue and response capacity of the system. In this respect, development laws and regulations should be connected to disaster laws. Development Law 3194 does not consider seismic risk as a factor in the settlement of areas. The law should be updated and used as a tool for diminishing the vulnerabilities of communities to seismic risk especially in metropolitan regions. Earthquake building codes should be implemented and strictly enforced to prevent illegal construction activities in metropolitan cities, especially in Istanbul.

Third, according to development laws, municipalities possess authority for settlement activities within cities. Controlling settlement activities is crucial for disaster mitigation. Municipalities do not have a direct responsibility for post-disaster operations. Province and district governments are primarily responsible for these activities. Disaster preparedness, response, recovery, and relief are four inseparable phases of disaster mitigation. Therefore, either municipalities should also be responsible for latter phases of disaster mitigation or province and district governments should have authority over settlement issues. The role of each organization within the system needs to be clearly defined in advance to avoid confusion during emergency.

Fourth, the General Directorate of Civil Defense established highly trained rescue groups in 11 cities and assigned these teams to particular cities. These rescue teams continually interact with each other. Through these groups, cities are connected for rescue operations after an earthquake occurs. However, this same connection cannot be claimed for disaster mitigation efforts. Responsible managers must prepare their organizations to conform to the requirements of disaster law and regulations. Most of the interviewees argued that disaster organizations, even within the same city, implement their plans and programs without interacting with other organizations. In fact, these organizations should connect their plans not only with organizations within the same city but also with organizations in neighbor cities.

9.5.3 Challenges from Organizational Perspectives

The evolution and changes in the response system from the Marmara to the Duzce earthquake are an indication of the complexity in disaster environments. Frequent interactions among disaster organizations from different jurisdictions and sectors create very intricate circumstances that make coordination of these interactions very difficult. Establishing the necessary information infrastructure is very important to supporting the interaction among disaster organizations during regular and emergency times. Without increasing the information search, acquisition, and exchange capacity of disaster organizations, it will be very difficult to establish connections among disaster organizations from different organizational and jurisdictional levels.

Increasing information capacity is important for continuous organizational learning and transformation to adapt to changing conditions in disaster environments. It is imperative for the Turkish disaster system to create an organizational structure that facilitates a culture that promotes openness to new information. In that sense, training and education are very important for responsible managers. Responsible managers from different organizations should learn to work together and to share disaster relevant information to better respond to the needs of communities under seismic risk.

Organizational flexibility is also an important challenge for Turkish pubic administration. It must create a more adaptive, self-governing disaster management system. Disaster laws and regulations should be more flexible to support deregulation of power and resources to local disaster organizations. Local disaster organizations should be supported by financial sources, trained personnel and technical equipment in order to act independently when an earthquake happens.

9.6 LIMITATIONS OF THE STUDY

This research examined two response systems, the Marmara and Duzce. While the research comprehensively examined two cases, it is hard to construct robust principles for such a social phenomenon involving complexity. It is important to be cautious in generalizing the results to different response systems occurring in different contexts. Multiple case studies, including more than two cases in different contexts (e.g. different countries), might produce stronger results that can help to generate benchmark principles. Therefore, it is important to conduct a future study that allows comparison of multiple cases from different contexts.

Hundreds of organizations were involved in the response operations and projects following the Marmara and Duzce earthquakes, however, experienced managers from only 39 organizations were interviewed due to budgetary and time constraints. Although I interviewed the elites in the Turkish disaster system, I acknowledge that interviewing all organizations from stricken communities would produce stronger outcomes. I also acknowledge that each interviewee had personal biases about the performance of his/her own organization and the entire disaster management system.

In this research, I sought to compare two response systems to evaluate the performance of the Turkish disaster system in terms of utilizing and exchanging disaster relevant information to support coordinated response operations. I used paired-t test based on two samples. Due to the small number of cases (19 for Duzce, and 39 for Marmara) and differences between the two earthquakes in terms of magnitude, and demographic conditions of areas that they struck, I acknowledge that the comparison results should be used carefully as indicators to show the difference between two response systems.

Lastly, the research is heavily reliant on data gathered from content analysis of newspapers, web sites of disaster organizations, and interviews. Network analyses and N-K methodology analysis are also based on this data. I analyzed inter-organizational coordination based on interactions among disaster organizations during the response operations, and advancement in organizational and informational structure after the earthquakes. One should accept that the data set could not cover all interactions and developments in the disaster system. Immense difficulties in obtaining data from public organizations in Turkey can be considered a limitation of the study as well.

9.7 FUTURE RESEARCH

This study examines the initial conditions of existing information infrastructure during the 1999 Marmara and Duzce response operations, compares two response systems, uncovers the gaps and evaluates the reforming activities that aim to close these gaps. The study mainly focuses on the Marmara region. Since 96% of the land in Turkey is exposed to seismic risk, a future study might cover all of the country in order to analyze to what extent Turkish public administration builds a disaster system that seeks to reduce the vulnerabilities of communities across the country to destructive disasters.

The study discovered that the Turkish disaster system learned from the Marmara earthquake and began to reform the system to better cope with future earthquakes. Large earthquakes do not occur frequently enough to keep communities alert. People tend to forget the outcomes of a destructive earthquake and eventually lose the sense of urgency to take necessary actions. A future study should examine to what extent the initiated projects to create a socio-technical Turkish disaster system continue in right direction.

Future research with multiple cases would be valuable to test the outcomes that this research produced. Multiple cases from different countries could be used to confirm whether the results are valid for other cases in different circumstances. A future study with more content analysis and more representative organizations from stricken communities could also strengthen the objectivity of the research findings.

APPENDIX A

INTERVIEW QUESTIONS

This investigation examines the potential of utilizing information systems to in disaster mitigation efforts. The purpose of the investigation is to discover, define, and evaluate the important issues regarding the uses of information and communication tools in creating coordinated response actions in emergencies.

a. Initial Conditions of Information Infrastructure

1. What is your organization's primary function?

__Crisis Management
__Research
__Health/Rehabilitation
__Public Safety
__Mass Care
__Communication
__Rescue
__Other ___

2. To what extent did information exchange exist between your organization and other disaster organizations during response operations?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

4. What kind of information and communication technologies did you use to transmit information to other organizations involved in the disaster operations process?

__GIS
__GPS
__Computer/Computer Networks
__Phone
__Satellite Phone

__Radio/Shortwave Radio
__TV
__Internet
__Megaphone
__Intelligent Reasoning
__Risk Assessment Models
__Other____

5. To what extent did your organizations utilize information and communication means in disaster operations?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

6a. Were you able to utilize any inter-organizational knowledge base during the disaster operations?

_yes _no _Other___

b. If, yes, which knowledge bases did you use?

c. If yes, how useful they were for decision-making?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

7. To what extent did the existing information systems provide timely and accurate information to support disaster organizations during the disaster operations?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

8. How do you rate performance of the information infrastructure in terms of exchanging necessary disaster relevant information and resources with local/provincial/central government?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

b. Current state of information infrastructure

9. To what extent is your organization currently able to use information and communication technologies to improve coordinated actions for disaster operations?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

10. What kinds of advanced information and communication technologies has your organization adopted after the 1999 earthquakes?

__GIS (or underdevelopment)
__GPS (or underdevelopment)
__Computer Networks (or underdevelopment)
__Intelligent Reasoning (or underdevelopment)
__Risk Assessment Models (or underdevelopment)
__Satellite based communication systems (or underdevelopment)
__Other __

If new technologies have been adopted;

11a. What are the financial sources of these investments?

__Central Government
__Local/provincial Government
__Private
__Nonprofit
__International
__Individual
__Other __

b. What are the most important factors in your organization's ability to utilize these tools? Please list them in accordance with significance.

_Trained Personnel
_Financial Assistance
_New Disaster Organizational Design
_Constant Updated Data from Disaster Locations
_Changes in Laws/Regulations/Policy
_Authority Deregulation
_Other__

12a. Do you currently share any databases with other organizations?

__No
__Yes

b. If yes, with which of following organizations?

Local level		public	nonprofit	private
Provincial level		public	nonprofit	private
Central level		public	nonprofit	private

Please name_______________

13. How often do you exchange disaster relevant information with other disaster organizations (public, nonprofit, private)?

_Daily
_Weekly
_Monthly
_Yearly
_Not at all
_Other

14. How do you scale the organizations, public, private, non-profit, in terms of their willingness to share information?

Public	high	medium	low
Private	high	medium	low
Nonprofit	high	medium	low

c. Local sustainability

15. What is your organization' primary source of funding?

__Government
__Donations
__Private Sources
__International Sources
__Individual
__Other

16. How often do you inform your personnel/citizens about important subjects related to disaster circumstances/policy?

_Always
_Very often
_Sometimes
_Rarely
_Never

_ Other

17. To what extent do you feel that you have all necessary information for emergency management purposes?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

18. To what extent do you have difficulties in obtaining information from other local, provincial, central disaster organizations –public, private and nonprofit-?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

19. To what extent do you have the capacity to implement and change disaster policies or reallocate resources?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

20. What do you believe are the most important factors that constrain your ability to take independent actions? Please list them in terms of importance to you.

_Financial
_Insufficient equipment
_Trained personnel
_Laws/regulations
_Political environment
_Other

d. Organizational changes and disaster mitigation

21. What sorts of significant changes have there been in your organization for the purposes of disaster management? Please list them in terms of importance to your daily operations?

__Changes in laws/regulations
__Changes in organizational structure
__Changes in financial conditions
__Changes in personnel
__Changes in technical capacity
__Investments in information infrastructure
__Other__

22. For what purposes have these changes been primarily carried out? Please order by priority given by your organization.

__Preparedness before an earthquake
__Response immediate after and earthquake
__Recover/Relief
__All above

23. To what extent have those changes in technical capacity and organizational design since the earthquakes increased/decreased the organizational flexibility of the disaster management system?

__Increased significantly
__Increased somewhat
__No change
__Decreased somewhat
__Decreased significantly
__Other

24. Does your organization currently have a regular training program for the purpose of disaster mitigation?

__yes __no __Other (please specify)

25. To what extent is the Turkish disaster system ready for future catastrophic earthquakes?

_Great extent _Good extent _Neither good nor bad
_Less than good _Not at all good _Other ____

26. What would you recommend to significantly increase the effectiveness of Turkish disaster management system? Please list them in accordance with importance to you.

__More investments in information infrastructure
__Increasing power of local public organizations
__Increasing number of trained personnel
__Establishing new emergency organizations
__Educating citizens
__Changing building codes
__Increasing enforcement for construction facilities
__Other (Comment) ___

e. Personal Information

27. How many years of service do you have with your organizations for the purposes of emergency management?

__1 year or less
__2-4
__5-7
__8-10
__more than 10 years

28. How many personnel does your organization have for emergency operations?

_1-5

_6-15

_16-25

_26-50

_over 50

29. Approximately, what is the total budget of your organization for recent fiscal year?

_0-25,000,000,000 TL
_25,000,000,001-75,000,000,000 TL
_75,000,000, 001-150,000,000,000 TL
_150,000,000, 001- 500, 000,000,000 TL
_More than 500, 000,000,000 TL

30. What is your last educational degree that you have completed?

__High school diploma
__Bachelor's Degree
__Master's
__PhD
__Other___

31. How old are you?

__20-30
__31-40
__41-50
__51-60
__61-over

32. Gender?

__Male
__Female

Are there any other issues that you want to mention?

____

____

____

____

APPENDIX B

DESTRUCTIVE EARTHQUAKES IN TURKEY, 1902-2005

Destructive Earthquakes in Turkey, 1902-2005					
Destructive earthquakes in Turkey					
Region	**Date (DD/MM/YYYY)**	**Magnitude (Ms)**	**Number of deaths**	**Number of injured**	**Number of Heavily damaged residencies**
Çankiri	09.03.1902	5.6	4	-	3000
Malazgirt	28.04.1903	6.7	2626	-	4500
Zara	10.02.1903	5.8	-	-	1500
Çemisgezek	04.12.1905	6.8	-	-	15
Mürefte	09.08.1912	7.3	216	466	5540
Afyon-Bolvadin	04.10.1914	5.1	400	-	1700
Çaykara	13.05.1924	5.3	50	-	700
Pasinler	13.09.1924	6.9	310	-	4300
Afyon-Dinar	07.08.1925	5.9	3	-	2043
Milas	08.02.1926	4.7	2	-	598
Finike	18.03.1926	6.9	27	-	190
Kars	22.10.1926	5.7	355	-	1100
Izmir-Torbali	31.03.1928	7	50	-	2100
Sivas-Susehri	18.05.1929	6.1	64	-	1357
Hakkari Siniri	06.05.1930	7.2	2514	-	3000
Denizli-Çivril	19.07.1933	5.7	20	-	200
Bingöl	15.12.1934	4.9	12	-	200
Erdek	04.01.1935	6.7	5	30	600
Digor	01.05.1935	6.2	200	-	1300
Kars-Kötek	23.03.1936	4.5	-	-	100
Kirsehir	19.04.1938	6.6	149	-	3860
Kirsehir	16.12.1938	4.8	-	-	300
Izmir-Dikili	22.09.1939	7.1	60	-	1235
Tercan	21.11.1939	5.9	43	-	500
Erzincan	26.12.1939	7.9	32968	-	116720
Nigde	10.01.1940	5	58	-	586
Kayseri-Develi	20.02.1940	6.7	37	20	530
Yozgat	13.04.1940	5.6	20	-	1250

Destructive Earthquakes in Turkey, 1902-2005					
Destructive earthquakes in Turkey					
Region	**Date (DD/MM/YYYY)**	**Magnitude (Ms)**	**Number of deaths**	**Number of injured**	**Number of Heavily damaged residencies**
Mugla	23.05.1941	6	2	-	500
Van-Ercis	10.09.1941	5.9	194	-	600
Erzincan	12.11.1941	5.9	15	-	500
Mugla	13.12.1941	5.7	-	-	400
Bigadiç-Sindirgi	15.11.1942	6.1	7	-	1262
Osmancik	21.11.1942	5.5	7	-	448
Çorum	11.12.1942	5.9	25	-	816
Niksar-Erbaa	20.12.1942	7	3000	6300	32000
Adapazari-Hendek	20.06.1943	6.6	336	-	2240
Tosya-Ladik	26.11.1943	7.2	2824	-	25000
Bolu-Gerede	01.02.1944	7.2	3959	-	20865
Düzce	10.02.1944	5.4	-	-	900
Mudurnu	05.04.1944	5.6	30	-	900
Gediz-Usak	25.06.1944	6.2	21	-	3476
Ayvalik-Edremit	06.10.1944	7	27	-	1158
Adana-Ceyhan	20.03.1945	6	10	-	650
Van	20.11.1945	5.8	-	-	1000
Kadinhan-Ilgin	21.02.1946	5.6	2	-	509
Varto-Hinis	31.05.1946	5.7	839	349	1986
Izmir-Karaburun	23.07.1949	7	1	7	824
Karliova	17.08.1949	7	450	-	3000
Harmancik	05.02.1949	5.2	-	-	150
Kigi	04.02.1950	4.6	20	-	100
Iskenderun	08.04.1951	5.7	6	10	13
Kursunlu	13.08.1951	6.9	52	208	3354
Hasankale	03.01.1952	5.8	133	-	701
Misis	22.10.1952	5.5	10	-	511
Yenice-Gönen	18.03.1953	7.4	265	336	9670
Karaburun	02.05.1953	5.1	-	-	73
Kursunlu	07.09.1953	6.4	2	-	230
Edirne	18.06.1953	5.1	-	-	323
Aydin-Söke	16.07.1955	7	23	-	470
Eskisehir	20.02.1956	6.4	2	-	1219
Fethiye	25.04.1957	7.1	67	-	3100
Bolu-Abant	26.05.1957	7.1	52	100	4201
Basköy	07.07.1957	5.1	-	-	300
Köycegiz	25.04.1959	5.7	-	-	59
Hinis	25.10.1959	5	18	-	300
Bitlis	26.02.1960	4	-	-	80
Germencik	10.04.1960	4.4	-	-	100
Tokat	26.07.1960	4.6	-	-	22
Marmaris	23.05.1961	6.5	-	9	61

Destructive Earthquakes in Turkey, 1902-2005					
Destructive earthquakes in Turkey					
Region	**Date (DD/MM/YYYY)**	**Magnitude (Ms)**	**Number of deaths**	**Number of injured**	**Number of Heavily damaged residencies**
Mus	10.02.1962	4	-	-	97
Igdir	04.09.1962	5.3	1	22	-
Denizli	11.03.1963	5.5	-	-	54
Çinarcik-Yalova	18.09.1963	6.3	1	26	230
Denizli	22.11.1963	5.1	-	-	298
Siirt	24.03.1964	4	1	-	100
Malatya	14.06.1964	6	8	36	678
Manyas	06.10.1964	7	23	130	5398
Denizli-Honaz	13.06.1965	5.7	14	217	488
Karliova	31.08.1965	5.6	-	-	1500
Varto	07.03.1966	5.6	14	75	1100
Varto	12.07.1966	4	12	-	90
Varto	19.08.1966	6.9	2394	1489	20007
Adana-Bahçe	07.04.1966	4.8	-	-	100
Adapazari	22.07.1967	7.2	89	235	5569
Pülümür	26.07.1967	6.2	97	268	1282
Akyazi	30.07.1967	6	2	40	-
Adana-Bahçe	07.04.1967	5.3	-	-	91
Bingöl-Elazig	24.09.1968	5.1	2	40	-
Amasya-Bartin	03.09.1968	6.5	29	231	2073
Fethiye	14.01.1969	6.2	-	-	42
Gönen	03.03.1969	5.7	1	-	20
Demirci	23.03.1969	6.1	-	-	1100
Demirci	25.03.1969	6	-	-	1826
Alasehir	28.03.1969	6.6	41	186	4372
Karaburun	06.04.1969	5.6	-	3	443
Gediz	28.03.1970	7.2	1086	1260	9452
Çavdarhisar-Kütahya	19.04.1970	5.9	-	2	41
Demirci	23.04.1970	5.7	-	43	150
Gürün	02.07.1970	4.8	1	-	150
Burdur	12.05.1971	6.2	57	57	3227
Bingöl	22.05.1971	6.7	878	878	9111
Ezine	26.04.1972	5	-	-	400
Sarikamis	22.03.1972	4.7	-	4	100
Van	16.07.1972	5.2	1	-	400
Izmir	01.02.1974	5.2	2	20	47
Kars-Susuz	25.03.1975	5.1	2	26	762
Lice	06.09.1975	6.9	2385	3339	8149
Dogu Beyazit	02.04.1976	4.8	5	13	236
Denizli	19.08.1976	4.9	4	28	887
Ardahan	30.04.1976	5	4	-	300
Çaldiran-Muradiye	24.11.1976	7.2	3840	497	9552

Destructive Earthquakes in Turkey, 1902-2005					
Destructive earthquakes in Turkey					
Region	**Date (DD/MM/YYYY)**	**Magnitude (Ms)**	**Number of deaths**	**Number of injured**	**Number of Heavily damaged residencies**
Lice	25.03.1977	4.8	8	17	210
Palu	26.03.1977	5.2	8	26	842
Izmir	09.12.1977	4.8	-	-	11
Izmir	16.12.1977	5.3	-	-	40
Foça	14.06.1979	5.9	-	-	22
Antakya	30.06.1981	4.4	-	-	2
Mus-Bulanik	27.03.1982	5.2	-	-	424
Biga	05.07.1983	4.9	3	-	85
Erzurum-Kars	30.10.1983	6.8	1155	1142	3241
Erzurum-Balkaya	18.09.1984	5.9	3	35	187
Malatya-Sürgü	05.05.1986	5.8	8	24	824
Sürgü-Malatya	06.06.1986	5.6	1	20	1174
Kars-Akyaka	07.12.1988	6.9	4	11	546
Erzincan-Tunceli	13.03.1992	6.8	653	3850	8057
Dinar	01.10.1995	5.9	94	240	14156
Çorum-Amasya	14.08.1996	5.4	-	6	707
Antakya	22.01.1997	5.4	1	-	1841
Bingol-Karliova	13.04.1998	5	-	-	148
Adana-Ceyhan	27.06.1998	5.9	146	1041	4000
17 Agustos Kocaeli	17.08.1999	7.4	17480	43953	244,383
Bolu-Duzce	12.11.1999	7.2	763	4948	133,496
Cankiri-Orta	06.06.2000	6.1	2	-	1766
Sakarya-Hendek	23.08.2000	5.8	-	9	-
Afyon-Sultandagi	15.12.2000	5.8	6	-	547
Osmaniye	25.06.2001	5.5	-	-	66
Afyon-Cay-Sultandagi	03.02.2002	6.4	44	-	622
Tunceli-Pulumur	27.01.2003	6.2	1	7	-
Bingol	01.05.2003	6.4	176	520	6000
Erzurum-Cat	25.03.2004	5.1	9	20	1280
Agri Dogubeyazit	02.07.2004	5.1	18	32	1000
Elazig-Sivrice	11.08.2004	5.5	-	12	-
Hakkari	25.01.2004	5.5	2	5	159
Bingol-Karliova	12.03.2005	5.7	-	16	758
Sources: Adapted from Boazici Universtiy Kandilli Observatory (www.koeri.boun.edu.tr/sismo), Earthquake Research Instittution National Earthquake Monitoring Center (www.angora.deprem.gov.tr), Primime Ministry Crisis Management Center (2001), Belgenet webpage (www.belgenet.deprem),					

APPENDIX C

DATA SOURCES FOR PROJECTS

Content Analysis of Newspapers

Cumhuriyet, Science & Technology Section, May 1998-May 2005

Interviewees

Interviewee # Ahmet Bumin

Interviewee # Aziz Sasa

Interviewee # Dilek Kocak

Interviewee # Ismail Eroglu

Interviewee # Oktay Ergunay

Interviewee # Ramazan Tuncer

Reports

Report by Mustafa Erdik "Strong Data Acquisition, Processing and Utilization in Turkey”

Web Sites

http://www.cedm.itu.edu.tr (Istanbul Technical University, Center of Excellence for Disaster Management)

http://www.cendim.boun.edu.tr/ (Bogazici University Center for Disaster Management) http://www.deprem.cs.itu.edu.tr (Istanbul Technical University, Earthquake Prediction Project)

http://www.deprem.gov.tr (Earthquake research Department, General Directorate of Disaster Affairs)

http://www.duzce-bld.gov.tr (Duzce Municipality)

http://www.ibb.gov.tr (Istanbul Greater (Metropolitan) Municipality)

http://www.ins.itu.edu.tr (Istanbul Technical University, Civil Engineering Department)

http://www.istanbul.gov.tr (Istanbul Province Government)

http://www.jica.go.jp/turkey (Japan International Cooperation Agency/Turkey)

http://www.kizilay.org.tr (Turkish Red Crescent)

http://www.koeri.boun.edu.tr/depremmuh/ (Bogazici University and Kandilli Observatory)

http://www.koeri.boun.edu.tr/jeodezi (Bogazici University Geodesy Engineering Department)

http://www.pub.gov.tr/projects.html (Prime Ministry Project Implementation Unit)

http://www.sakarya.gov.tr (Sakarya Province Government)

http://www.tkgm.gov.tr (General Directorate of Land Registry and Cadastre)

http://www.tubitak.gov.tr (The Scientific and Technological Research Council of Turkey)

http://www.yildiz.edu.tr (Yildiz Technical University)

APPENDIX D

COMPARISON OF THE MARMARA AND DUZCE RESPONSE SYSTEM

Table D-1 Utilizing Information and Communication Systems

"To what extent did your organizations utilize these tools in disaster operations?"

Paired T test for Duzce and Marmara

	N	Mean	StDev	SE Mean
Duzce	35	2.88571	1.79495	0.30340
Marmara	35	2.22857	1.21476	0.20533
Differences	35	0.657143	1.908847	0.322654

95% lower bound for mean difference: 0.111559
T-Test of mean difference = 0 (vs > 0): T-Value = 2.04 P-Value = 0.025

Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Table D-2 Information Exchange among Disaster Organizations

"To what extent did the information exchange exist between your organization and other organizations during response operations?"

Paired T test for Duzce and Marmara

	N	Mean	StDev	SE Mean
Duzce	35	2.80000	1.71155	0.28931
Marmara	35	2.08571	0.88688	0.14991
Differences	35	0.714286	1.887598	0.319062

95% lower bound for mean difference: 0.174776
T-Test of mean difference = 0 (vs > 0): T-Value = 2.24 P-Value = 0.016
P-Value =0.000

Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Table D-3 Effectiveness of Information Systems

"To what extent did the existing information systems provide timely and accurate information to support disaster organizations during the disaster operations?"

Paired T test for Duzce and Marmara

	N	Mean	StDev	SE Mean
Duzce	35	2.91429	1.82098	0.30780
Marmara	35	2.05714	1.05560	0.17843
Differences	35	0.857143	1.880908	0.317931

95% lower bound for mean difference: 0.319545
T-Test of mean difference = 0 (vs > 0): T-Value = 2.70 P-Value = 0.005

Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Table D-4 The performance of Turkish Disaster System in terms of Information Infrastructure

"How do you rate performance of the information infrastructure in terms of exchanging necessary disaster relevant information and resources with local/provincial/central government?"

Paired T test for Duzce and Marmara

	N	Mean	StDev	SE Mean
Duzce	38	2.76316	1.82230	0.29562
Marmara	38	1.76316	0.78617	0.12753
Differences	38	1.00000	1.98644	0.32224

95% lower bound for mean difference: 0.45635
T-Test of mean difference = 0 (vs > 0): T-Value = 3.10 P-Value = 0.002

Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Table D-5 Availability of Inter-organizational Knowledge base Systems

"Were you able to utilize any inter-organizational knowledge base during the disaster operations?"						
	Marmara		Duzce		All Earthquakes	
	Responses	%	Responses	%	Responses	%
Yes	3	7.7	2	10.5	5	8.6
No	36	92.3	17	89.5	53	91.4
Total responses	39	100	19	100	58	100.0

Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Table D-6 Effectiveness of Inter-organizational Knowledge base

"If yes, how useful were they for decision-making?"						
	Marmara		Duzce		All Earthquakes	
	Responses	%	Responses	%	Responses	%
Great extent	1	33.3	1	50	2	40.0
Good extent	1	33.3	1	50	2	40.0
Neither good or bad	1	33.3	0	0.0	1	20.0
Less than good	0	0.0	0	0.0	0	0.0
Not at all good	0	0.0	0	0.0	0	0.0
Total responses	3	100	2	100	5	100.0

Sources: Semi-Structured Interviews with Turkish Experts in Disaster Management (June 1-July 27, 2004)

Table D-7 Utilization of Information Systems after the Earthquakes

"To what extent is your organization currently able to use information and communication technologies to improve coordinated actions for disaster operations?"		
	Responses	%
Great extent	0	0.0
Good extent	18	48.6
Neither good or bad	12	32.4
Less than good	6	16.2
Not at all good	1	2.7
Total responses	37	100

Table D-8 Independent actions

"To what extent do you have the capacity to implement and change disaster policies or reallocate resources?"		
	Number	%
Great extent	1	2.9
Good extent	4	11.4
Neither good or bad	15	42.9
Less than good	14	40.0
Not at all good	1	2.9
Other:	4	0.0
Total responses	35	100.0

APPENDIX E

CENTRALITY MEASUREMENTS: THE MARMARA RESPONSE OPERATIONS

Table E- 1 Freeman's Degree Centrality Measures

		1	2	3	4
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
		------------	------------	------------	------------
7	Kizilay	26.000	6.000	3.916	0.904
3	Interior M.	22.000	1.000	3.313	0.151
1	PMCMC	21.000	25.000	3.163	3.765
5	Military	18.000	12.000	2.711	1.807
13	KOCMC	17.000	49.000	2.560	7.380
83	National Education M.	13.000	2.000	1.958	0.301
4	Health M	11.000	2.000	1.657	0.301
98	TEAS	10.000	0.000	1.506	0.000
9	BOCMC	10.000	31.000	1.506	4.669
110	TBF	9.000	0.000	1.355	0.000
2	PWSM	8.000	3.000	1.205	0.452
99	TEDAS	7.000	0.000	1.054	0.000
36	BOTAS	7.000	0.000	1.054	0.000
94	Central M. HG	6.000	0.000	0.904	0.000
49	E.Natural Resources M.	6.000	0.000	0.904	0.000
12	ISCMC	6.000	27.000	0.904	4.066
114	TRAC	6.000	0.000	0.904	0.000
107	TPAO	5.000	0.000	0.753	0.000
10	BUCMC	5.000	4.000	0.753	0.602
103	TKI	5.000	0.000	0.753	0.000
90	Religious A.A.	5.000	0.000	0.753	0.000
67	Izmir Province	5.000	0.000	0.753	0.000
66	ISKI	5.000	0.000	0.753	0.000
52	Esenyurt Mu.	5.000	0.000	0.753	0.000
46	Dokuzeylul U.	5.000	1.000	0.753	0.151
27	ANCMC	4.000	0.000	0.602	0.000
14	YACMC	4.000	42.000	0.602	6.325
71	KOCI	4.000	1.000	0.602	0.151
93	SSK	4.000	1.000	0.602	0.151
50	Environment M.	4.000	4.000	0.602	0.602
34	Bartin P.	4.000	0.000	0.602	0.000
75	L. Social S M.	4.000	1.000	0.602	0.151
64	Istanbul T. Un.	3.000	1.000	0.452	0.151
100	TEKEL	3.000	0.000	0.452	0.000
43	D.Public Sec.	3.000	2.000	0.452	0.301
105	TOKI	3.000	1.000	0.452	0.151
57	HEA	3.000	1.000	0.452	0.151
82	National Defense M.	3.000	1.000	0.452	0.151
11	SACMC	3.000	42.000	0.452	6.325
53	Eskisehir P.	3.000	3.000	0.452	0.452

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
24	Ankara GCMu.	3.000	1.000	0.452	0.151
22	ACC	3.000	0.000	0.452	0.000
45	Diyarbakir P.	3.000	0.000	0.452	0.000
56	GPO	3.000	0.000	0.452	0.000
79	MLSA	2.000	0.000	0.301	0.000
80	Mugla P	2.000	1.000	0.301	0.151
47	Duzce Mu.	2.000	0.000	0.301	0.000
15	AIBU	2.000	1.000	0.301	0.151
69	Kirsehir Mu.	2.000	0.000	0.301	0.000
118	Turkish Petrolum A.S.	2.000	0.000	0.301	0.000
21	AKUT	2.000	1.000	0.301	0.151
32	Bahcelievler Mu.	2.000	0.000	0.301	0.000
48	Edirne P.	2.000	0.000	0.301	0.000
44	D.Rural Af.	2.000	0.000	0.301	0.000
106	Tourism M.	2.000	2.000	0.301	0.301
6	SSCP	2.000	1.000	0.301	0.151
78	Ministers Cabinet	2.000	4.000	0.301	0.602
42	D.Disaster Af.	2.000	4.000	0.301	0.602
54	F.Rural Af. M.	2.000	1.000	0.301	0.151
20	Aksaray P.	2.000	0.000	0.301	0.000
108	TRT CYA	2.000	0.000	0.301	0.000
84	National Security Council	2.000	0.000	0.301	0.000
97	TAECA	2.000	3.000	0.301	0.452
41	D.Civil Def.	2.000	3.000	0.301	0.452
51	Eregli SH	1.000	0.000	0.151	0.000
40	Dinar Mu.	1.000	0.000	0.151	0.000
18	ALC	1.000	0.000	0.151	0.000
61	ISDEMIR	1.000	0.000	0.151	0.000
60	I.Commerce M.	1.000	0.000	0.151	0.000
68	Justice M.	1.000	0.000	0.151	0.000
19	ASH	1.000	0.000	0.151	0.000
70	Kirsehir P.	1.000	0.000	0.151	0.000
30	ACA	1.000	0.000	0.151	0.000
59	IEIS	1.000	0.000	0.151	0.000
33	BSNI H.	1.000	0.000	0.151	0.000
76	Manisa P.	1.000	0.000	0.151	0.000
55	Giresun P.	1.000	0.000	0.151	0.000
58	HRDF	1.000	0.000	0.151	0.000
29	Antalya P.	1.000	0.000	0.151	0.000
39	Bursa YI H.	1.000	0.000	0.151	0.000
81	Narlidere Mu.	1.000	0.000	0.151	0.000
113	Turkey Sea Aut.	1.000	0.000	0.151	0.000
63	IDH	1.000	0.000	0.151	0.000
38	Bursa St. H.	1.000	0.000	0.151	0.000
65	Istanbul Un.	1.000	0.000	0.151	0.000
86	Office of Agricultural Produces	1.000	0.000	0.151	0.000
26	Ankara NH	1.000	0.000	0.151	0.000
25	AIEA	1.000	0.000	0.151	0.000
89	Public Education Centers	1.000	2.000	0.151	0.301
91	Samsun P.	1.000	0.000	0.151	0.000
111	TDA	1.000	0.000	0.151	0.000
92	SHF	1.000	0.000	0.151	0.000
73	Kocaeli Un.	1.000	2.000	0.151	0.301
115	TDA	1.000	0.000	0.151	0.000
95	Central M.SS	1.000	0.000	0.151	0.000
96	Central M. SU	1.000	0.000	0.151	0.000
77	ME Union	1.000	0.000	0.151	0.000
37	Bursa SSK	1.000	0.000	0.151	0.000
16	ADRC	1.000	0.000	0.151	0.000
17	ARA M.	1.000	3.000	0.151	0.452
101	D.Mining T.R.	1.000	0.000	0.151	0.000
102	T?GEM	1.000	0.000	0.151	0.000
62	ICC	1.000	1.000	0.151	0.151
104	TOBB	1.000	1.000	0.151	0.151
85	Nigde P.	1.000	0.000	0.151	0.000
23	AFAFAC	1.000	0.000	0.151	0.000
87	President Demirel	1.000	0.000	0.151	0.000

		OutDegree	InDegree	NrmOutDeg	NrmInDeg
35	BCA	1.000	0.000	0.151	0.000
119	TUROB	1.000	1.000	0.151	0.151
28	AESOB	1.000	0.000	0.151	0.000
121	Yildiz T. Un.	1.000	0.000	0.151	0.000
112	THW Union	1.000	0.000	0.151	0.000
120	Uludag Un.	1.000	0.000	0.151	0.000
31	AYEA	1.000	0.000	0.151	0.000
117	T.National A.	1.000	1.000	0.151	0.151
116	THF	1.000	0.000	0.151	0.000
122	Zeytinburnu Mu.	1.000	0.000	0.151	0.000
72	Kocaeli Mu.	0.000	1.000	0.000	0.151
109	TUPRAS	0.000	1.000	0.000	0.151
88	Prime M.	0.000	2.000	0.000	0.301
8	Regional CMC	0.000	14.000	0.000	2.108
74	KorfezCMC	0.000	2.000	0.000	0.301
123	Balikesir Un.	0.000	1.000	0.000	0.151
124	Bandirma Dist.	0.000	1.000	0.000	0.151
125	Bolu Mu.	0.000	1.000	0.000	0.151
126	Bakirkoy S.H.	0.000	1.000	0.000	0.151
127	CilimliCMC	0.000	1.000	0.000	0.151
128	D.B.Land R.	0.000	1.000	0.000	0.151
129	D.Highways	0.000	1.000	0.000	0.151
130	DEGCMC	0.000	6.000	0.000	0.904
131	DUZCMC	0.000	6.000	0.000	0.904
132	DISK	0.000	0.000	0.000	0.000
133	GebzeCMC	0.000	2.000	0.000	0.301
135	Golcuk Muni.	0.000	5.000	0.000	0.753
136	Golyaka CMC	0.000	3.000	0.000	0.452
137	Golcuk S.H.	0.000	1.000	0.000	0.151
138	Gebze H. T. Institute	0.000	2.000	0.000	0.301
139	Foreign Aff. M.	0.000	1.000	0.000	0.151
140	Finance M.	0.000	2.000	0.000	0.301
141	HRA	0.000	1.000	0.000	0.151
142	Izmir Mu.	0.000	1.000	0.000	0.151
143	Istanbul Mu.	0.000	2.000	0.000	0.301
144	IGSAS	0.000	1.000	0.000	0.151
145	IZAYDAS	0.000	2.000	0.000	0.301
146	Izmit S.H.	0.000	1.000	0.000	0.151
147	ISBA	0.000	0.000	0.000	0.000
148	KaramurselCMC	0.000	7.000	0.000	1.054
149	KandiraCMC	0.000	1.000	0.000	0.151
150	Kocaeli SSK H.	0.000	1.000	0.000	0.151
151	MF	0.000	0.000	0.000	0.000
152	METU	0.000	2.000	0.000	0.301
153	PETKIM	0.000	0.000	0.000	0.000
154	Avcilar Dist.	0.000	2.000	0.000	0.301
155	Sakarya Uni.	0.000	2.000	0.000	0.301
156	Provinces B.	0.000	1.000	0.000	0.151
157	Sakarya S.H.	0.000	1.000	0.000	0.151
158	SSCPD	0.000	1.000	0.000	0.151
159	Central M. RKY	0.000	1.000	0.000	0.151
160	Treasury	0.000	1.000	0.000	0.151
161	TUROB	0.000	1.000	0.000	0.151
162	TEC	0.000	1.000	0.000	0.151
163	D.S.Railways	0.000	1.000	0.000	0.151
164	Yalova SSK HC	0.000	1.000	0.000	0.151
165	ZB	0.000	1.000	0.000	0.151
166	ZONCMC	0.000	3.000	0.000	0.452

DESCRIPTIVE STATISTICS

	1	2	3	4
	OutDegree	InDegree	NrmOutDeg	NrmInDeg
1 Mean	2.410	2.410	0.363	0.363
2 Std Dev	4.018	7.032	0.605	1.059
3 Sum	400.000	400.000	60.241	60.241
4 Variance	16.145	49.447	0.366	1.122
5 SSQ	3644.000	9172.000	82.650	208.031
6 MCSSQ	2680.145	8208.145	60.789	186.170
7 Euc Norm	60.366	95.771	9.091	14.423
8 Minimum	0.000	0.000	0.000	0.000
9 Maximum	26.000	49.000	3.916	7.380

Network Centralization (Outdegree) = 3.596%

Network Centralization (Indegree) = 7.102%

Table E- 2 Closeness Centrality Measures

		1	2
		Farness	nCloseness
		------------	------------
1	PMCMC	1982.000	8.325
13	KOCMC	1988.000	8.300
7	Kizilay	2002.000	8.242
11	SACMC	2006.000	8.225
5	Military	2016.000	8.185
14	YACMC	2020.000	8.168
9	BOCMC	2023.000	8.156
2	PWSM	2032.000	8.120
36	BOTAS	2042.000	8.080
3	Interior M.	2051.000	8.045
83	National Education M.	2055.000	8.029
12	ISCMC	2059.000	8.014
110	TBF	2060.000	8.010
93	SSK	2063.000	7.998
4	Health M	2063.000	7.998
49	E.Natural Resources M.	2071.000	7.967
114	TRAC	2074.000	7.956
98	TEAS	2076.000	7.948
90	Religious A.A.	2076.000	7.948
103	TKI	2076.000	7.948
99	TEDAS	2076.000	7.948
107	TPAO	2076.000	7.948
66	ISKI	2076.000	7.948
94	Central M. HG	2077.000	7.944
50	Environment M.	2077.000	7.944
8	Regional CMC	2082.000	7.925
78	Ministers Cabinet	2083.000	7.921
42	D.Disaster Af.	2086.000	7.910
134	GOLCMC	2088.000	7.902
41	D.Civil Def.	2090.000	7.895
53	Eskisehir P.	2091.000	7.891
52	Esenyurt Mu.	2092.000	7.887
131	DUZCMC	2095.000	7.876
34	Bartin P.	2095.000	7.876
79	MLSA	2097.000	7.868
148	KaramurselCMC	2097.000	7.868
82	National Defense M.	2098.000	7.865
89	Public Education Centers	2101.000	7.853
10	BUCMC	2107.000	7.831
75	L. Social S M.	2111.000	7.816
100	TEKEL	2112.000	7.813
88	Prime M.	2114.000	7.805
54	F.Rural Af. M.	2117.000	7.794
136	Golyaka CMC	2118.000	7.790
135	Golcuk Muni.	2119.000	7.787
24	Ankara GCMu.	2121.000	7.779
27	ANCMC	2121.000	7.779
22	ACC	2122.000	7.776
45	Diyarbakir P.	2122.000	7.776
21	AKUT	2124.000	7.768
6	SSCP	2125.000	7.765
44	D.Rural Af.	2127.000	7.757
48	Edirne P.	2130.000	7.746
130	DEGCMC	2130.000	7.746
140	Finance M.	2130.000	7.746
20	Aksaray P.	2130.000	7.746
106	Tourism M.	2132.000	7.739
104	TOBB	2133.000	7.736
73	Kocaeli Un.	2134.000	7.732
80	Mugla P	2136.000	7.725
165	ZB	2136.000	7.725
23	AFAFAC	2136.000	7.725

		1	2
		Farness	nCloseness
61	ISDEMIR	2136.000	7.725
159	Central M. RKY	2136.000	7.725
156	Provinces B.	2136.000	7.725
77	ME Union	2136.000	7.725
113	Turkey Sea Aut.	2136.000	7.725
74	KorfezCMC	2140.000	7.710
60	I.Commerce M.	2142.000	7.703
149	KandiraCMC	2142.000	7.703
87	President Demirel	2142.000	7.703
29	Antalya P.	2142.000	7.703
138	Gebze H. T. Institute	2142.000	7.703
33	BSNI H.	2142.000	7.703
72	Kocaeli Mu.	2142.000	7.703
146	Izmit S.H.	2142.000	7.703
28	AESOB	2142.000	7.703
15	AIBU	2143.000	7.699
155	Sakarya Uni.	2154.000	7.660
56	GPO	2154.000	7.660
154	Avcilar Dist.	2156.000	7.653
126	Bakirkoy S.H.	2156.000	7.653
164	Yalova SSK HC	2156.000	7.653
150	Kocaeli SSK H.	2156.000	7.653
112	THW Union	2156.000	7.653
127	CilimliCMC	2156.000	7.653
139	Foreign Aff. M.	2156.000	7.653
111	TDA	2156.000	7.653
118	Turkish Petrolum A.S.	2157.000	7.650
71	KOCI	2158.000	7.646
32	Bahcelievler Mu.	2159.000	7.642
133	GebzeCMC	2160.000	7.639
122	Zeytinburnu Mu.	2160.000	7.639
43	D.Public Sec.	2160.000	7.639
85	Nigde P.	2160.000	7.639
46	Dokuzeylul U.	2162.000	7.632
152	METU	2166.000	7.618
16	ADRC	2170.000	7.604
68	Justice M.	2170.000	7.604
124	Bandirma Dist.	2170.000	7.604
38	Bursa St. H.	2174.000	7.590
37	Bursa SSK	2174.000	7.590
39	Bursa YI H.	2174.000	7.590
69	Kirsehir Mu.	2174.000	7.590
120	Uludag Un.	2174.000	7.590
70	Kirsehir P.	2174.000	7.590
67	Izmir Province	2176.000	7.583
51	Eregli SH	2177.000	7.579
19	ASH	2177.000	7.579
105	TOKI	2180.000	7.569
166	ZONCMC	2194.000	7.521
143	Istanbul Mu.	2211.000	7.463
47	Duzce Mu.	2211.000	7.463
117	T.National A.	2212.000	7.459
26	Ankara NH	2213.000	7.456
65	Istanbul Un.	2213.000	7.456
59	IEIS	2217.000	7.442
145	IZAYDAS	2217.000	7.442
17	ARA M.	2230.000	7.399
158	SSCPD	2231.000	7.396
116	THF	2236.000	7.379
55	Giresun P.	2236.000	7.379
81	Narlidere Mu.	2236.000	7.379
76	Manisa P.	2236.000	7.379
92	SHF	2236.000	7.379
31	AYEA	2236.000	7.379
30	ACA	2237.000	7.376
84	National Security Council	2237.000	7.376

		1	2
		Farness	nCloseness
58	HRDF	2242.000	7.360
62	ICC	2243.000	7.356
142	Izmir Mu.	2246.000	7.346
57	HEA	2264.000	7.288
108	TRT CYA	2269.000	7.272
97	TAECA	2272.000	7.262
25	AIEA	2279.000	7.240
119	TUROB	2286.000	7.218
161	TUROB	2286.000	7.218
123	Balikesir Un.	2288.000	7.212
40	Dinar Mu.	2294.000	7.193
64	Istanbul T. Un.	2314.000	7.131
137	Golcuk S.H.	2316.000	7.124
129	D.Highways	2330.000	7.082
95	Central M.SS	2334.000	7.069
160	Treasury	2334.000	7.069
63	IDH	2365.000	6.977
86	Office of Agricultural Produces	2384.000	6.921
102	T?GEM	2384.000	6.921
18	ALC	2384.000	6.921
121	Yildiz T. Un.	2418.000	6.824
163	D.S.Railways	2423.000	6.810
162	TEC	2426.000	6.801
141	HRA	2426.000	6.801
115	TDA	2426.000	6.801
101	D.Mining T.R.	2468.000	6.686
144	IGSAS	2468.000	6.686
109	TUPRAS	2468.000	6.686
157	Sakarya S.H.	27225.000	0.606
91	Samsun P.	27225.000	0.606
96	Central M. SU	27225.000	0.606
128	D.B.Land R.	27225.000	0.606
125	Bolu Mu.	27225.000	0.606
35	BCA	27225.000	0.606
147	ISBA		
132	DISK		
153	PETKIM		
151	MF		

Statistics

		1	2
		Farness	nCloseness
		------------	------------
1	Mean	3098.321	7.359
2	Std Dev	4732.671	1.366
3	Sum	501928.000	1192.078
4	Variance	22398176.000	1.865
5	SSQ	5183638528.000	9074.090
6	MCSSQ	3628504576.000	302.179
7	Euc Norm	71997.492	95.258
8	Minimum	1982.000	0.606
9	Maximum	27225.000	8.325

Table E- 3 Betweenness Centrality Measures

		1	2
		Betweenness	nBetweenness
		------------	------------
1	PMCMC	2552.156	9.431
13	KOCMC	1922.243	7.104
7	Kizilay	804.001	2.971
5	Military	762.387	2.817
9	BOCMC	762.234	2.817
14	YACMC	730.218	2.699
11	SACMC	610.451	2.256
50	Environment M.	447.167	1.653
2	PWSM	317.500	1.173
3	Interior M.	285.000	1.053
12	ISCMC	260.467	0.963
75	L. Social S M.	206.533	0.763
83	National Education M.	196.867	0.728
71	KOCI	190.917	0.706
106	Tourism M.	179.000	0.661
89	Public Education Centers	170.867	0.631
78	Ministers Cabinet	146.333	0.541
4	Health M	115.000	0.425
15	AIBU	112.000	0.414
73	Kocaeli Un.	89.000	0.329
62	ICC	87.000	0.322
105	TOKI	60.000	0.222
57	HEA	60.000	0.222
6	SSCP	59.000	0.218
54	F.Rural Af. M.	59.000	0.218
104	TOBB	57.000	0.211
42	D.Disaster Af.	18.708	0.069
10	BUCMC	9.250	0.034
21	AKUT	8.933	0.033
93	SSK	6.667	0.025
97	TAECA	6.000	0.022
46	Dokuzeylul U.	4.000	0.015
82	National Defense M.	3.601	0.013
64	Istanbul T. Un.	3.000	0.011
17	ARA M.	3.000	0.011
117	T.National A.	0.500	0.002
18	ALC	0.000	0.000
19	ASH	0.000	0.000
25	AIEA	0.000	0.000
8	Regional CMC	0.000	0.000
29	Antalya P.	0.000	0.000
20	Aksaray P.	0.000	0.000
31	AYEA	0.000	0.000
39	Bursa YI H.	0.000	0.000
38	Bursa St. H.	0.000	0.000
26	Ankara NH	0.000	0.000
45	Diyarbakir P.	0.000	0.000
28	AESOB	0.000	0.000
49	E.Natural Resources M.	0.000	0.000
40	Dinar Mu.	0.000	0.000
51	Eregli SH	0.000	0.000
27	ANCMC	0.000	0.000
33	BSNI H.	0.000	0.000
24	Ankara GCMu.	0.000	0.000
35	BCA	0.000	0.000
36	BOTAS	0.000	0.000
47	Duzce Mu.	0.000	0.000
58	HRDF	0.000	0.000
59	IEIS	0.000	0.000
60	I.Commerce M.	0.000	0.000
61	ISDEMIR	0.000	0.000
16	ADRC	0.000	0.000

		1	2
		Betweenness	nBetweenness
53	Eskisehir P.	0.000	0.000
44	D.Rural Af.	0.000	0.000
65	Istanbul Un.	0.000	0.000
66	ISKI	0.000	0.000
67	Izmir Province	0.000	0.000
68	Justice M.	0.000	0.000
69	Kirsehir Mu.	0.000	0.000
70	Kirsehir P.	0.000	0.000
30	ACA	0.000	0.000
72	Kocaeli Mu.	0.000	0.000
32	Bahcelievler Mu.	0.000	0.000
74	KorfezCMC	0.000	0.000
55	Giresun P.	0.000	0.000
76	Manisa P.	0.000	0.000
77	ME Union	0.000	0.000
37	Bursa SSK	0.000	0.000
79	MLSA	0.000	0.000
80	Mugla P	0.000	0.000
81	Narlidere Mu.	0.000	0.000
41	D.Civil Def.	0.000	0.000
43	D.Public Sec.	0.000	0.000
84	National Security Council	0.000	0.000
85	Nigde P.	0.000	0.000
86	Office of Agricultural Produces	0.000	0.000
87	President Demirel	0.000	0.000
88	Prime M.	0.000	0.000
48	Edirne P.	0.000	0.000
90	Religious A.A.	0.000	0.000
91	Samsun P.	0.000	0.000
92	SHF	0.000	0.000
52	Esenyurt Mu.	0.000	0.000
94	Central M. HG	0.000	0.000
95	Central M.SS	0.000	0.000
96	Central M. SU	0.000	0.000
56	GPO	0.000	0.000
98	TEAS	0.000	0.000
99	TEDAS	0.000	0.000
100	TEKEL	0.000	0.000
101	D.Mining T.R.	0.000	0.000
102	T?GEM	0.000	0.000
103	TKI	0.000	0.000
63	IDH	0.000	0.000
22	ACC	0.000	0.000
23	AFAFAC	0.000	0.000
107	TPAO	0.000	0.000
108	TRT CYA	0.000	0.000
109	TUPRAS	0.000	0.000
110	TBF	0.000	0.000
111	TDA	0.000	0.000
112	THW Union	0.000	0.000
113	Turkey Sea Aut.	0.000	0.000
114	TRAC	0.000	0.000
115	TDA	0.000	0.000
116	THF	0.000	0.000
34	Bartin P.	0.000	0.000
118	Turkish Petrolum A.S.	0.000	0.000
119	TUROB	0.000	0.000
120	Uludag Un.	0.000	0.000
121	Yildiz T. Un.	0.000	0.000
122	Zeytinburnu Mu.	0.000	0.000
123	Balikesir Un.	0.000	0.000
124	Bandirma Dist.	0.000	0.000
125	Bolu Mu.	0.000	0.000
126	Bakirkoy S.H.	0.000	0.000
127	CilimliCMC	0.000	0.000
128	D.B.Land R.	0.000	0.000

		1	2
		Betweenness	nBetweenness
129	D.Highways	0.000	0.000
130	DEGCMC	0.000	0.000
131	DUZCMC	0.000	0.000
132	DISK	0.000	0.000
133	GebzeCMC	0.000	0.000
134	GOLCMC	0.000	0.000
135	Golcuk Muni.	0.000	0.000
136	Golyaka CMC	0.000	0.000
137	Golcuk S.H.	0.000	0.000
138	Gebze H. T. Institute	0.000	0.000
139	Foreign Aff. M.	0.000	0.000
140	Finance M.	0.000	0.000
141	HRA	0.000	0.000
142	Izmir Mu.	0.000	0.000
143	Istanbul Mu.	0.000	0.000
144	IGSAS	0.000	0.000
145	IZAYDAS	0.000	0.000
146	Izmit S.H.	0.000	0.000
147	ISBA	0.000	0.000
148	KaramurselCMC	0.000	0.000
149	KandiraCMC	0.000	0.000
150	Kocaeli SSK H.	0.000	0.000
151	MF	0.000	0.000
152	METU	0.000	0.000
153	PETKIM	0.000	0.000
154	Avcilar Dist.	0.000	0.000
155	Sakarya Uni.	0.000	0.000
156	Provinces B.	0.000	0.000
157	Sakarya S.H.	0.000	0.000
158	SSCPD	0.000	0.000
159	Central M. RKY		
0.000	0.000		
160	Treasury	0.000	0.000
161	TUROB	0.000	0.000
162	TEC	0.000	0.000
163	D.S.Railways	0.000	0.000
164	Yalova SSK HC	0.000	0.000
165	ZB	0.000	0.000
166	ZONCMC	0.000	0.000

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1	2
		Betweenness	nBetweenness
		------------	------------
1	Mean	68.108	0.252
2	Std Dev	278.363	1.029
3	Sum	11306.000	41.781
4	Variance	77485.914	1.058
5	SSQ	13632696.000	186.177
6	MCSSQ	12862662.000	175.661
7	Euc Norm	3692.248	13.645
8	Minimum	0.000	0.000
9	Maximum	2552.156	9.431

Network Centralization Index = 9.24%

Table E- 4 Flow Betweenness Centrality Measures

		1	2
		FlowBet	nFlowBet
		------------	------------
1	PMCMC	4303.363	15.903
2	PWSM	138.376	0.511
3	Interior M.	663.691	2.453
4	Health M	121.500	0.449
5	Military	507.704	1.876
6	SSCP	58.000	0.214
7	Kizilay	660.041	2.439
8	Regional CMC	0.000	0.000
9	BOCMC	1192.773	4.408
10	BUCMC	229.450	0.848
11	SACMC	301.230	1.113
12	ISCMC	177.000	0.654
13	KOCMC	1440.825	5.325
14	YACMC	1275.794	4.715
15	AIBU	116.000	0.429
16	ADRC	0.000	0.000
17	ARA M.	0.000	0.000
18	ALC	0.000	0.000
19	ASH	0.000	0.000
20	Aksaray P.	0.000	0.000
21	AKUT	1.667	0.006
22	ACC	0.000	0.000
23	AFAFAC	0.000	0.000
24	Ankara GCMu.	0.750	0.003
25	AIEA	0.000	0.000
26	Ankara NH	0.000	0.000
27	ANCMC	0.000	0.000
28	AESOB	0.000	0.000
29	Antalya P.	0.000	0.000
30	ACA	0.000	0.000
31	AYEA	0.000	0.000
32	Bahcelievler Mu.	0.000	0.000
33	BSNI H.	0.000	0.000
34	Bartin P.	0.000	0.000
35	BCA	0.000	0.000
36	BOTAS	0.000	0.000
37	Bursa SSK	0.000	0.000
38	Bursa St. H.	0.000	0.000
39	Bursa YI H.	0.000	0.000
40	Dinar Mu.	0.000	0.000
41	D.Civil Def.	0.377	0.001
42	D.Disaster Af.	6.250	0.023
43	D.Public Sec.	0.000	0.000
44	D.Rural Af.	0.000	0.000
45	Diyarbakir P.	0.000	0.000
46	Dokuzeylul U.	5.500	0.020
47	Duzce Mu.	0.000	0.000
48	Edirne P.	0.000	0.000
49	E.Natural Resources M.	0.000	0.000
50	Environment M.	517.727	1.913
51	Eregli SH	0.000	0.000
52	Esenyurt Mu.	0.000	0.000
53	Eskisehir P.	0.402	0.001
54	F.Rural Af. M.	58.000	0.214
55	Giresun P.	0.000	0.000
56	GPO	0.000	0.000
57	HEA	58.000	0.214
58	HRDF	0.000	0.000
59	IEIS	0.000	0.000
60	I.Commerce M.	0.000	0.000
61	ISDEMIR	0.000	0.000
62	ICC	294.936	1.090

		1	2
		FlowBet	nFlowBet
63	IDH	0.000	0.000
64	Istanbul T. Un.	0.000	0.000
65	Istanbul Un.	0.000	0.000
66	ISKI	0.000	0.000
67	Izmir Province	0.000	0.000
68	Justice M.	0.000	0.000
69	Kirsehir Mu.	0.000	0.000
70	Kirsehir P.	0.000	0.000
71	KOCI	377.136	1.394
72	Kocaeli Mu.	0.000	0.000
73	Kocaeli Un.	89.000	0.329
74	KorfezCMC	0.000	0.000
75	L. Social S M.	177.067	0.654
76	Manisa P.	0.000	0.000
77	ME Union	0.000	0.000
78	Ministers Cabinet	121.500	0.449
79	MLSA	0.000	0.000
80	Mugla P	0.000	0.000
81	Narlidere Mu.	0.000	0.000
82	National Defense M.	178.519	0.660
83	National Education M.	75.730	0.280
84	National Security Council	0.000	0.000
85	Nigde P.	0.000	0.000
86	Office of Agricultural Produces	0.000	0.000
87	President Demirel	0.000	0.000
88	Prime M.	0.000	0.000
89	Public Education Centers	101.330	0.374
90	Religious A.A.	0.000	0.000
91	Samsun P.	0.000	0.000
92	SHF	0.000	0.000
93	SSK	1.667	0.006
94	Central M. HG	0.000	0.000
95	Central M.SS	0.000	0.000
96	Central M. SU	0.000	0.000
97	TAECA	2.000	0.007
98	TEAS	0.000	0.000
99	TEDAS	0.000	0.000
100	TEKEL	0.000	0.000
101	D.Mining T.R.	0.000	0.000
102	T?GEM	0.000	0.000
103	TKI	0.000	0.000
104	TOBB	263.936	0.975
105	TOKI	58.000	0.214
106	Tourism M.	179.000	0.661
107	TPAO	0.000	0.000
108	TRT CYA	0.000	0.000
109	TUPRAS	0.000	0.000
110	TBF	0.000	0.000
111	TDA	0.000	0.000
112	THW Union	0.000	0.000
113	Turkey Sea Aut.	0.000	0.000
114	TRAC	0.000	0.000
115	TDA	0.000	0.000
116	THF	0.000	0.000
117	T.National A.	0.000	0.000
118	Turkish Petrolum A.S.	0.000	0.000
119	TUROB	0.000	0.000
120	Uludag Un.	0.000	0.000
121	Yildiz T. Un.	0.000	0.000
122	Zeytinburnu Mu.	0.000	0.000
123	Balikesir Un.	0.000	0.000
124	Bandirma Dist.	0.000	0.000
125	Bolu Mu.	0.000	0.000
126	Bakirkoy S.H.	0.000	0.000
127	CilimliCMC	0.000	0.000
128	D.B.Land R.	0.000	0.000

		1	2
		FlowBet	nFlowBet
129	D.Highways	0.000	0.000
130	DEGCMC	0.000	0.000
131	DUZCMC	0.000	0.000
132	DISK	0.000	0.000
133	GebzeCMC	0.000	0.000
134	GOLCMC	0.000	0.000
135	Golcuk Muni.	0.000	0.000
136	Golyaka CMC	0.000	0.000
137	Golcuk S.H.	0.000	0.000
138	Gebze H. T. Institute	0.000	0.000
139	Foreign Aff. M.	0.000	0.000
140	Finance M.	0.000	0.000
141	HRA	0.000	0.000
142	Izmir Mu.	0.000	0.000
143	Istanbul Mu.	0.000	0.000
144	IGSAS	0.000	0.000
145	IZAYDAS	0.000	0.000
146	Izmit S.H.	0.000	0.000
147	ISBA	0.000	0.000
148	KaramurselCMC	0.000	0.000
149	KandiraCMC	0.000	0.000
150	Kocaeli SSK H.	0.000	0.000
151	MF	0.000	0.000
152	METU	0.000	0.000
153	PETKIM	0.000	0.000
154	Avcilar Dist.	0.000	0.000
155	Sakarya Uni.	0.000	0.000
156	Provinces B.	0.000	0.000
157	Sakarya S.H.	0.000	0.000
158	SSCPD	0.000	0.000
159	Central M. RKY		
0.000	0.000		
160	Treasury	0.000	0.000
161	TUROB	0.000	0.000
162	TEC	0.000	0.000
163	D.S.Railways	0.000	0.000
164	Yalova SSK HC	0.000	0.000
165	ZB	0.000	0.000
166	ZONCMC	0.000	0.000

Network Centralization Index = 15.691%

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1	2
		FlowBet	nFlowBet
1	Mean	82.857	0.306
2	Std Dev	384.770	1.422
3	Sum	13754.238	50.829
4	Variance	148048.328	2.022
5	SSQ	25715656.000	351.190
6	MCSSQ	24576022.000	335.626
7	Euc Norm	5071.061	18.740
8	Minimum	0.000	0.000
9	Maximum	4303.363	15.903

Table E- 5 Cliques for the Marmara response system

1:	PMCMC Kizilay SACMC KOCMC
2:	PMCMC PWSM SACMC KOCMC
3:	PMCMC SACMC KOCMC BOTAS
4:	PMCMC SACMC KOCMC SSK
5:	Health M SACMC KOCMC
6:	Interior M. SACMC KOCMC Eskisehir P.
7:	SACMC KOCMC Aksaray P.
8:	SACMC KOCMC ACC
9:	SACMC KOCMC Ankara GCMu. ANCMC
10:	SACMC KOCMC Bartin P.
11:	SACMC KOCMC Edirne P.
12:	SACMC KOCMC E.Natural Resources M.
13:	SACMC KOCMC Eskisehir P. National Education M.
14:	SACMC KOCMC ISKI
15:	SACMC KOCMC Religious A.A.
16:	SACMC KOCMC Central M. HG
17:	SACMC KOCMC TEAS
18:	SACMC KOCMC TEDAS
19:	SACMC KOCMC TKI
20:	SACMC KOCMC TPAO
21:	SACMC KOCMC TBF
22:	Kizilay SACMC KOCMC TRAC
23:	Interior M. Military KOCMC D.Civil Def.
24:	PMCMC Military Kizilay KOCMC
25:	PWSM KOCMC D.Disaster Af.
26:	PMCMC KOCMC Environment M.
27:	PMCMC KOCMC Ministers Cabinet
28:	PMCMC Kizilay Regional CMC
29:	PMCMC Regional CMC F.Rural Af. M.
30:	PMCMC Regional CMC National Defense M.
31:	PMCMC PWSM BOCMC SACMC
32:	PMCMC Kizilay BOCMC SACMC
33:	PMCMC BOCMC SACMC BOTAS
34:	Interior M. BOCMC SACMC Eskisehir P.
35:	Health M BOCMC SACMC
36:	BOCMC SACMC AIBU
37:	BOCMC SACMC ACC
38:	BOCMC SACMC Ankara GCMu. ANCMC
39:	BOCMC SACMC Bartin P.
40:	BOCMC SACMC E.Natural Resources M.
41:	BOCMC SACMC Eskisehir P. National Education M.
42:	BOCMC SACMC ISKI
43:	BOCMC SACMC Religious A.A.
44:	BOCMC SACMC TEAS
45:	BOCMC SACMC TEDAS
46:	BOCMC SACMC TKI
47:	BOCMC SACMC TPAO
48:	BOCMC SACMC TBF
49:	Kizilay BOCMC DUZCMC
50:	Interior M. BOCMC Golcuk Muni.
51:	BOCMC TBF KaramurselCMC
52:	Interior M. BUCMC YACMC
53:	BUCMC YACMC National Education M.
54:	BUCMC YACMC Central M. HG
55:	Interior M. BUCMC GOLCMC
56:	ISCMC TBF GebzeCMC
57:	ISCMC TBF GOLCMC
58:	ISCMC TBF KaramurselCMC
59:	Interior M. ISCMC GOLCMC
60:	Interior M. ISCMC Golcuk Muni.
61:	ISCMC E.Natural Resources M. GOLCMC
62:	Kizilay ISCMC TRAC
63:	PMCMC Military Kizilay YACMC
64:	PMCMC PWSM YACMC
65:	PMCMC YACMC BOTAS

66:	PMCMC YACMC SSK
67:	Interior M. Military YACMC
68:	PWSM YACMC Esenyurt Mu.
69:	Dokuzeylul U. Izmir Province DEGCMC
70:	Military GPO DUZCMC
71:	Environment M. KOCI IZAYDAS
72:	PMCMC Military L. Social S M.
73:	PMCMC L. Social S M. SSK
74:	PMCMC Military National Defense M.
75:	PMCMC National Defense M. Golyaka CMC
76:	PMCMC Military Prime M.
77:	PMCMC Military Public Education Centers
78:	Military Kizilay DUZCMC
79:	Interior M. Military D.Civil Def. GOLCMC
80:	PMCMC Kizilay Golyaka CMC

APPENDIX F

CENTRALITY MEASUREMENTS FOR THE DUZCE RESPONSE OPERATIONS

Table F-1 Freeman's Degree Centrality Measures

		1	2	3	4
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
		------------	------------	------------	------------
33	Health M.	13.000	0.000	2.006	0.000
16	Military	10.000	7.000	1.543	1.080
54	Kizilay	9.000	1.000	1.389	0.154
1	PMCMC	6.000	2.000	0.926	0.309
24	MTS	6.000	0.000	0.926	0.000
25	D.P.Safety	6.000	0.000	0.926	0.000
60	Prime Ministry	5.000	1.000	0.772	0.154
38	Istanbul P.	5.000	2.000	0.772	0.309
37	Istanbul G.C. Mu.	4.000	1.000	0.617	0.154
53	Kayseri P.	4.000	0.000	0.617	0.000
49	Izmir P.	4.000	0.000	0.617	0.000
21	Corum P.	3.000	0.000	0.463	0.000
18	Balikesir S.R.	3.000	0.000	0.463	0.000
30	Etibank Mining	3.000	0.000	0.463	0.000
47	Izmir Heath D.P.	3.000	1.000	0.463	0.154
13	Balikesir Civil D.D.	3.000	0.000	0.463	0.000
31	Finance M.	2.000	0.000	0.309	0.000
55	KOERI	2.000	0.000	0.309	0.000
19	Cankiri P.	2.000	0.000	0.309	0.000
17	BOP	2.000	0.000	0.309	0.000
8	Ankara G.C. Mu	2.000	0.000	0.309	0.000
9	Ankara P.	2.000	0.000	0.309	0.000
23	D. Highways	2.000	1.000	0.309	0.154
32	GMWU	2.000	0.000	0.309	0.000
65	SUBA	2.000	0.000	0.309	0.000
2	Bolu CMC	2.000	19.000	0.309	2.932
14	Balikesir HD	2.000	0.000	0.309	0.000
67	TAECA	2.000	1.000	0.309	0.154
62	Sakarya P.	2.000	0.000	0.309	0.000
70	Transportation M.	2.000	0.000	0.309	0.000
64	Central Ministry	2.000	0.000	0.309	0.000
50	Karabuk P.	2.000	0.000	0.309	0.000
7	Ankara Civil D.D.	2.000	0.000	0.309	0.000
22	D. Civil D.	2.000	0.000	0.309	0.000
76	Zonguldak P.	2.000	0.000	0.309	0.000
75	TELECOM	2.000	0.000	0.309	0.000
15	Bartin P.	1.000	0.000	0.154	0.000
29	Erzurum P.	1.000	0.000	0.154	0.000
58	President Demirel	1.000	1.000	0.154	0.154
5	Afyon Mu.	1.000	0.000	0.154	0.000
34	Icel P.	1.000	0.000	0.154	0.000

		1	2	3	4
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
41	Istanbul H.D.	1.000	1.000	0.154	0.154
57	Labor S.S. M.	1.000	1.000	0.154	0.154
66	SOC	1.000	0.000	0.154	0.000
39	Istanbul Civil D.D.	1.000	1.000	0.154	0.154
46	Izmir G.C. Mu.	1.000	1.000	0.154	0.154
20	Civil C.C.	1.000	0.000	0.154	0.000
42	Maltepe Mu.	1.000	0.000	0.154	0.000
36	IGEC	1.000	0.000	0.154	0.000
44	Bagcilar Mu.	1.000	0.000	0.154	0.000
45	Kartal Mu.	1.000	0.000	0.154	0.000
52	KNED	1.000	0.000	0.154	0.000
59	PWSM	1.000	3.000	0.154	0.463
27	Edirne P.D.	1.000	0.000	0.154	0.000
28	Erzincan P.	1.000	0.000	0.154	0.000
56	Konya P.	1.000	0.000	0.154	0.000
51	Kayseri GC Mu.	1.000	0.000	0.154	0.000
71	TUBITAK	1.000	0.000	0.154	0.000
11	Ardagan P.	1.000	0.000	0.154	0.000
6	AKUT	1.000	0.000	0.154	0.000
61	RPP	1.000	0.000	0.154	0.000
35	Interior M.	1.000	0.000	0.154	0.000
43	Bakirkoy Mu.	1.000	0.000	0.154	0.000
10	Antalya P.	1.000	0.000	0.154	0.000
68	Tekirdag P.	1.000	0.000	0.154	0.000
72	TRF	1.000	0.000	0.154	0.000
40	Istanbul P.D	1.000	3.000	0.154	0.463
74	TNA	1.000	1.000	0.154	0.154
69	Trabzon GC.Mu.	1.000	0.000	0.154	0.000
63	Samsun P.	1.000	0.000	0.154	0.000
48	IPC	1.000	0.000	0.154	0.000
73	TCA	1.000	2.000	0.154	0.309
26	D.Religious Af.	0.000	1.000	0.000	0.154
4	Kaynasli CMC	0.000	9.000	0.000	1.389
12	Balikesir P.	0.000	3.000	0.000	0.463
3	Duzce CMC	0.000	59.000	0.000	9.105
77	Zonguldak Mun	0.000	1.000	0.000	0.154
78	Ankara P. HD.	0.000	2.000	0.000	0.309
79	Ankara Un.	0.000	1.000	0.000	0.154
80	Aydin H.D.	0.000	1.000	0.000	0.154
81	Balikesir Mu.	0.000	3.000	0.000	0.463
82	Bartin H.D.	0.000	1.000	0.000	0.154
83	Bolu P.D.	0.000	2.000	0.000	0.309
84	Bosphorus Un.	0.000	2.000	0.000	0.309
85	Bolu R. Af.	0.000	1.000	0.000	0.154
86	Cankiri H.D	0.000	1.000	0.000	0.154
87	Corum H.D.	0.000	1.000	0.000	0.154
88	Duzce R. Af	0.000	1.000	0.000	0.154
89	Diyarbakir Civil D. D.	0.000	1.000	0.000	0.154
90	DSHW.	0.000	1.000	0.000	0.154
91	Duzce S.H.	0.000	1.000	0.000	0.154
92	Eskisehir H.D.	0.000	1.000	0.000	0.154
93	Golyaka R. Af.	0.000	1.000	0.000	0.154
94	Gulhane M.M.S.	0.000	1.000	0.000	0.154
95	Icel ED.	0.000	1.000	0.000	0.154
96	Justice M.	0.000	1.000	0.000	0.154
97	Istanbul T. University	0.000	3.000	0.000	0.463
98	Izmir P.D.	0.000	1.000	0.000	0.154
99	Kizilay	0.000	1.000	0.000	0.154
100	Konya H.D.	0.000	1.000	0.000	0.154
101	Kutahya H.D,	0.000	1.000	0.000	0.154
102	Karabuk H.D.	0.000	1.000	0.000	0.154
103	Kayseri Civil D.D.	0.000	1.000	0.000	0.154
104	Kayseri P.D.	0.000	1.000	0.000	0.154
105	Kaynasli Rel. Af.	0.000	1.000	0.000	0.154
106	Manisa H.D.	0.000	1.000	0.000	0.154
107	NSC	0.000	2.000	0.000	0.309

		1	2	3	4
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
108	Yalova P.D.	0.000	1.000	0.000	0.154
109	Zonguldak HD.	0.000	1.000	0.000	0.154

DESCRIPTIVE STATISTICS

		1	2	3	4
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
		------------	------------	------------	------------
1	Mean	1.495	1.495	0.231	0.231
2	Std Dev	2.084	5.936	0.322	0.916
3	Sum	163.000	163.000	25.154	25.154
4	Variance	4.342	35.241	0.103	0.839
5	SSQ	717.000	4085.000	17.075	97.284
6	MCSSQ	473.248	3841.248	11.270	91.479
7	Euc Norm	26.777	63.914	4.132	9.863
8	Minimum	0.000	0.000	0.000	0.000
9	Maximum	13.000	59.000	2.006	9.105

Network Centralization (Outdegree) = 1.792%

Network Centralization (Indegree) = 8.956%

Table F- 2 Closeness Centrality Measures

		1	2
		Farness	nCloseness
		------------	------------
3	Duzce CMC	1584.000	6.818
16	Military	1630.000	6.626
33	Health M.	1635.000	6.606
54	Kizilay	1636.000	6.601
38	Istanbul P.	1649.000	6.549
37	Istanbul G.C. Mu.	1650.000	6.545
60	Prime Ministry	1651.000	6.541
8	Ankara G.C. Mu	1655.000	6.526
22	D. Civil D.	1655.000	6.526
65	SUBA	1655.000	6.526
70	Transportation M.	1655.000	6.526
75	TELECOM	1655.000	6.526
19	Cankiri P.	1657.000	6.518
59	PWSM	1658.000	6.514
2	Bolu CMC	1659.000	6.510
40	Istanbul P.D	1662.000	6.498
41	Istanbul H.D.	1666.000	6.483
39	Istanbul Civil D.D.	1666.000	6.483
25	D.P.Safety	1671.000	6.463
14	Balikesir HD	1672.000	6.459
57	Labor S.S. M.	1672.000	6.459
73	TCA	1672.000	6.459
49	Izmir P.	1672.000	6.459
47	Izmir Heath D.P.	1672.000	6.459
21	Corum P.	1673.000	6.455
18	Balikesir S.R.	1674.000	6.452
13	Balikesir Civil D.D.	1674.000	6.452
30	Etibank Mining	1674.000	6.452
53	Kayseri P.	1674.000	6.452
46	Izmir G.C. Mu.	1676.000	6.444
51	Kayseri GC Mu.	1678.000	6.436
29	Erzurum P.	1678.000	6.436
44	Bagcilar Mu.	1678.000	6.436
69	Trabzon GC.Mu.	1678.000	6.436
63	Samsun P.	1678.000	6.436
62	Sakarya P.	1678.000	6.436
10	Antalya P.	1678.000	6.436
5	Afyon Mu.	1678.000	6.436
52	KNED	1678.000	6.436
28	Erzincan P.	1678.000	6.436
43	Bakirkoy Mu.	1678.000	6.436
42	Maltepe Mu.	1678.000	6.436
56	Konya P.	1678.000	6.436
45	Kartal Mu.	1678.000	6.436
72	TRF	1678.000	6.436
35	Interior M.	1678.000	6.436
48	IPC	1678.000	6.436
11	Ardagan P.	1678.000	6.436
1	PMCMC	1689.000	6.394
4	Kaynasli CMC	1707.000	6.327
7	Ankara Civil D.D.	1722.000	6.272
94	Gulhane M.M.S.	1724.000	6.265
78	Ankara P. HD.	1725.000	6.261
74	TNA	1726.000	6.257
109	Zonguldak HD.	1729.000	6.246
100	Konya H.D.	1729.000	6.246
82	Bartin H.D.	1729.000	6.246
91	Duzce S.H.	1729.000	6.246
92	Eskisehir H.D.	1729.000	6.246
86	Cankiri H.D	1729.000	6.246
101	Kutahya H.D,	1729.000	6.246
23	D. Highways	1730.000	6.243

		1	2
		Farness	nCloseness
32	GMWU	1733.000	6.232
64	Central Ministry	1735.000	6.225
58	President Demirel	1740.000	6.207
66	SOC	1743.000	6.196
31	Finance M.	1750.000	6.171
17	BOP	1751.000	6.168
50	Karabuk P.	1751.000	6.168
61	RPP	1753.000	6.161
6	AKUT	1753.000	6.161
99	Kizilay	1753.000	6.161
15	Bartin P.	1753.000	6.161
83	Bolu P.D.	1763.000	6.126
76	Zonguldak P.	1764.000	6.122
81	Balikesir Mu.	1764.000	6.122
12	Balikesir P.	1764.000	6.122
108	Yalova P.D.	1765.000	6.119
80	Aydin H.D.	1766.000	6.116
98	Izmir P.D.	1766.000	6.116
106	Manisa H.D.	1766.000	6.116
87	Corum H.D.	1767.000	6.112
103	Kayseri Civil D.D.	1768.000	6.109
104	Kayseri P.D.	1768.000	6.109
90	DSHW.	1783.000	6.057
107	NSC	1783.000	6.057
67	TAECA	1799.000	6.003
68	Tekirdag P.	1801.000	5.997
89	Diyarbakir Civil D. D.	1816.000	5.947
9	Ankara P.	1817.000	5.944
96	Justice M.	1845.000	5.854
102	Karabuk H.D.	1845.000	5.854
27	Edirne P.D.	1857.000	5.816
77	Zonguldak Mun	1858.000	5.813
20	Civil C.C.	1893.000	5.705
26	D.Religious Af.	1911.000	5.651
24	MTS	10910.000	0.990
97	Istanbul T. University	10913.000	0.990
85	Bolu R. Af.	10917.000	0.989
88	Duzce R. Af	10917.000	0.989
79	Ankara Un.	10917.000	0.989
93	Golyaka R. Af.	10917.000	0.989
105	Kaynasli Rel. Af.	10917.000	0.989
36	IGEC	10920.000	0.989
71	TUBITAK	10920.000	0.989
84	Bosphorus Un.	11664.000	0.926
34	Icel P.	11664.000	0.926
95	Icel ED.	11664.000	0.926
55	KOERI	11664.000	0.926

Statistics

		1	2
		Farness	nCloseness
		------------	------------
1	Mean	2840.661	5.666
2	Std Dev	3059.317	1.740
3	Sum	309632.000	617.586
4	Variance	9359420.000	3.029
5	SSQ	1899736192.000	3829.345
6	MCSSQ	1020176768.000	330.149
7	Euc Norm	43585.965	61.882
8	Minimum	1584.000	0.926
9	Maximum	11664.000	6.818

Table F-3 Betweenness Centrality Measures

		1	2
		Betweenness	nBetweenness
		------------	------------
16	Military	225.167	1.948
2	Bolu CMC	171.833	1.487
1	PMCMC	157.167	1.360
37	Istanbul G.C. Mu.	88.833	0.769
38	Istanbul P.	82.000	0.710
60	Prime Ministry	33.000	0.286
23	D. Highways	18.000	0.156
54	Kizilay	15.000	0.130
74	TNA	3.000	0.026
58	President Demirel	3.000	0.026
47	Izmir Heath D.P.	2.000	0.017
59	PWSM	2.000	0.017
67	TAECA	1.000	0.009
57	Labor S.S. M.	1.000	0.009
73	TCA	1.000	0.009
9	Ankara P.	0.000	0.000
12	Balikesir P.	0.000	0.000
15	Bartin P.	0.000	0.000
18	Balikesir S.R.	0.000	0.000
7	Ankara Civil D.D.	0.000	0.000
8	Ankara G.C. Mu	0.000	0.000
22	D. Civil D.	0.000	0.000
17	BOP	0.000	0.000
24	MTS	0.000	0.000
25	D.P.Safety	0.000	0.000
26	D.Religious Af.	0.000	0.000
14	Balikesir HD	0.000	0.000
28	Erzincan P.	0.000	0.000
29	Erzurum P.	0.000	0.000
30	Etibank Mining	0.000	0.000
31	Finance M.	0.000	0.000
32	GMWU	0.000	0.000
33	Health M.	0.000	0.000
21	Corum P.	0.000	0.000
35	Interior M.	0.000	0.000
36	IGEC	0.000	0.000
10	Antalya P.	0.000	0.000
11	Ardagan P.	0.000	0.000
39	Istanbul Civil D.D.	0.000	0.000
40	Istanbul P.D	0.000	0.000
41	Istanbul H.D.	0.000	0.000
42	Maltepe Mu.	0.000	0.000
43	Bakirkoy Mu.	0.000	0.000
44	Bagcilar Mu.	0.000	0.000
45	Kartal Mu.	0.000	0.000
46	Izmir G.C. Mu.	0.000	0.000
34	Icel P.	0.000	0.000
48	IPC	0.000	0.000
49	Izmir P.	0.000	0.000
50	Karabuk P.	0.000	0.000
51	Kayseri GC Mu.	0.000	0.000
52	KNED	0.000	0.000
53	Kayseri P.	0.000	0.000
27	Edirne P.D.	0.000	0.000
55	KOERI	0.000	0.000
56	Konya P.	0.000	0.000
3	Duzce CMC	0.000	0.000
4	Kaynasli CMC	0.000	0.000
5	Afyon Mu.	0.000	0.000
6	AKUT	0.000	0.000
61	RPP	0.000	0.000
62	Sakarya P.	0.000	0.000

		1	2
		Betweenness	nBetweenness
63	Samsun P.	0.000	0.000
64	Central Ministry	0.000	0.000
65	SUBA	0.000	0.000
66	SOC	0.000	0.000
13	Balikesir Civil D.D.	0.000	0.000
68	Tekirdag P.	0.000	0.000
69	Trabzon GC.Mu.	0.000	0.000
70	Transportation M.	0.000	0.000
71	TUBITAK	0.000	0.000
72	TRF	0.000	0.000
19	Cankiri P.	0.000	0.000
20	Civil C.C.	0.000	0.000
75	TELECOM	0.000	0.000
76	Zonguldak P.	0.000	0.000
77	Zonguldak Mun	0.000	0.000
78	Ankara P. HD.	0.000	0.000
79	Ankara Un.	0.000	0.000
80	Aydin H.D.	0.000	0.000
81	Balikesir Mu.	0.000	0.000
82	Bartin H.D.	0.000	0.000
83	Bolu P.D.	0.000	0.000
84	Bosphorus Un.	0.000	0.000
85	Bolu R. Af.	0.000	0.000
86	Cankiri H.D	0.000	0.000
87	Corum H.D.	0.000	0.000
88	Duzce R. Af	0.000	0.000
89	Diyarbakir Civil D. D.	0.000	0.000
90	DSHW.	0.000	0.000
91	Duzce S.H.	0.000	0.000
92	Eskisehir H.D.	0.000	0.000
93	Golyaka R. Af.	0.000	0.000
94	Gulhane M.M.S.	0.000	0.000
95	Icel ED.	0.000	0.000
96	Justice M.	0.000	0.000
97	Istanbul T. University	0.000	0.000
98	Izmir P.D.	0.000	0.000
99	Kizilay	0.000	0.000
100	Konya H.D.	0.000	0.000
101	Kutahya H.D,	0.000	0.000
102	Karabuk H.D.	0.000	0.000
103	Kayseri Civil D.D.	0.000	0.000
104	Kayseri P.D.	0.000	0.000
105	Kaynasli Rel. Af.	0.000	0.000
106	Manisa H.D.	0.000	0.000
107	NSC	0.000	0.000
108	Yalova P.D.	0.000	0.000
109	Zonguldak HD.	0.000	0.000

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1	2
		Betweenness	nBetweenness
		------------	------------
1	Mean	7.376	0.064
2	Std Dev	32.521	0.281
3	Sum	804.000	6.957
4	Variance	1057.615	0.079
5	SSQ	121210.445	9.077
6	MCSSQ	115280.023	8.633
7	Euc Norm	348.153	3.013
8	Minimum	0.000	0.000
9	Maximum	225.167	1.948

Network Centralization Index = 1.90%

Table F-4 Flow Betweenness Centrality

		1	2
		FlowBet	nFlowBet
		------------	------------
1	PMCMC	258.000	2.233
2	Bolu CMC	172.833	1.496
3	Duzce CMC	0.000	0.000
4	Kaynasli CMC	0.000	0.000
5	Afyon Mu.	0.000	0.000
6	AKUT	0.000	0.000
7	Ankara Civil D.D.	0.000	0.000
8	Ankara G.C. Mu	0.000	0.000
9	Ankara P.	0.000	0.000
10	Antalya P.	0.000	0.000
11	Ardagan P.	0.000	0.000
12	Balikesir P.	0.000	0.000
13	Balikesir Civil D.D.	0.000	0.000
14	Balikesir HD	0.000	0.000
15	Bartin P.	0.000	0.000
16	Military	251.000	2.172
17	BOP	0.000	0.000
18	Balikesir S.R.	0.000	0.000
19	Cankiri P.	0.000	0.000
20	Civil C.C.	0.000	0.000
21	Corum P.	0.000	0.000
22	D. Civil D.	0.000	0.000
23	D. Highways	13.000	0.112
24	MTS	0.000	0.000
25	D.P.Safety	0.000	0.000
26	D.Religious Af.	0.000	0.000
27	Edirne P.D.	0.000	0.000
28	Erzincan P.	0.000	0.000
29	Erzurum P.	0.000	0.000
30	Etibank Mining	0.000	0.000
31	Finance M.	0.000	0.000
32	GMWU	0.000	0.000
33	Health M.	0.000	0.000
34	Icel P.	0.000	0.000
35	Interior M.	0.000	0.000
36	IGEC	0.000	0.000
37	Istanbul G.C. Mu.	66.667	0.577
38	Istanbul P.	56.000	0.485
39	Istanbul Civil D.D.	0.000	0.000
40	Istanbul P.D	0.000	0.000
41	Istanbul H.D.	0.000	0.000
42	Maltepe Mu.	0.000	0.000
43	Bakirkoy Mu.	0.000	0.000
44	Bagcilar Mu.	0.000	0.000
45	Kartal Mu.	0.000	0.000
46	Izmir G.C. Mu.	0.000	0.000
47	Izmir Heath D.P.	0.000	0.000
48	IPC	0.000	0.000
49	Izmir P.	0.000	0.000
50	Karabuk P.	0.000	0.000
51	Kayseri GC Mu.	0.000	0.000
52	KNED	0.000	0.000
53	Kayseri P.	0.000	0.000
54	Kizilay	0.000	0.000
55	KOERI	0.000	0.000
56	Konya P.	0.000	0.000
57	Labor S.S. M.	0.000	0.000
58	President Demirel	0.000	0.000
59	PWSM	0.000	0.000
60	Prime Ministry	26.000	0.225
61	RPP	0.000	0.000
62	Sakarya P.	0.000	0.000

		1 FlowBet	2 nFlowBet
63	Samsun P.	0.000	0.000
64	Central Ministry	0.000	0.000
65	SUBA	0.000	0.000
66	SOC	0.000	0.000
67	TAECA	0.000	0.000
68	Tekirdag P.	0.000	0.000
69	Trabzon GC.Mu.	0.000	0.000
70	Transportation M.	0.000	0.000
71	TUBITAK	0.000	0.000
72	TRF	0.000	0.000
73	TCA	0.000	0.000
74	TNA	0.000	0.000
75	TELECOM	0.000	0.000
76	Zonguldak P.	0.000	0.000
77	Zonguldak Mun	0.000	0.000
78	Ankara P. HD.	0.000	0.000
79	Ankara Un.	0.000	0.000
80	Aydin H.D.	0.000	0.000
81	Balikesir Mu.	0.000	0.000
82	Bartin H.D.	0.000	0.000
83	Bolu P.D.	0.000	0.000
84	Bosphorus Un.	0.000	0.000
85	Bolu R. Af.	0.000	0.000
86	Cankiri H.D	0.000	0.000
87	Corum H.D.	0.000	0.000
88	Duzce R. Af	0.000	0.000
89	Diyarbakir Civil D. D.	0.000	0.000
90	DSHW.	0.000	0.000
91	Duzce S.H.	0.000	0.000
92	Eskisehir H.D.	0.000	0.000
93	Golyaka R. Af.	0.000	0.000
94	Gulhane M.M.S.	0.000	0.000
95	Icel ED.	0.000	0.000
96	Justice M.	0.000	0.000
97	Istanbul T. University	0.000	0.000
98	Izmir P.D.	0.000	0.000
99	Kizilay	0.000	0.000
100	Konya H.D.	0.000	0.000
101	Kutahya H.D,	0.000	0.000
102	Karabuk H.D.	0.000	0.000
103	Kayseri Civil D.D.	0.000	0.000
104	Kayseri P.D.	0.000	0.000
105	Kaynasli Rel. Af.	0.000	0.000
106	Manisa H.D.	0.000	0.000
107	NSC	0.000	0.000
108	Yalova P.D.	0.000	0.000
109	Zonguldak HD.	0.000	0.000

Network Centralization Index = 2.186%

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1 FlowBet	2 nFlowBet
		------------	------------
1	Mean	7.739	0.067
2	Std Dev	38.472	0.333
3	Sum	843.500	7.299
4	Variance	1480.132	0.111
5	SSQ	167861.797	12.570
6	MCSSQ	161334.359	12.081
7	Euc Norm	409.709	3.545
8	Minimum	0.000	0.000
9	Maximum	258.000	2.233

Table F- 5 Cliques for the Duzce response system

1:	Duzce CMC Istanbul G.C. Mu. Istanbul P.
2:	Duzce CMC Istanbul P. Istanbul Civil D.D.
3:	Duzce CMC Istanbul P. Istanbul P.D
4:	Duzce CMC Istanbul P. Istanbul H.D.
5:	Duzce CMC Military Cankiri P.
6:	Duzce CMC Military Kizilay
7:	Duzce CMC Military Prime Ministry
8:	Duzce CMC Corum P. TCA
9:	Duzce CMC D.P.Safety Istanbul P.D
10:	Duzce CMC Izmir G.C. Mu. Izmir P.
11:	Duzce CMC Izmir Heath D.P. Izmir P.
12:	Duzce CMC Kizilay PWSM
13:	PMCMC Bolu CMC Military
14:	PMCMC Bolu CMC Finance M.
15:	PMCMC Bolu CMC Istanbul G.C. Mu.
16:	Bolu CMC Istanbul G.C. Mu. Istanbul P.
17:	Bolu CMC Military Kizilay
18:	Kaynasli CMC Military Kizilay

APPENDIX G

CENTRALITY MEASUREMENTS FOR THE PROJECT NETWORK

Table G-1 Freeman's Degree Centrality Measurements

			1	2	3	4
			OutDegree	InDegree	NrmOutDeg	NrmInDeg
			------------	------------	------------	------------
1.	76	ESC	30.000	0.000	4.902	0.000
2.	1	BU-KOERI	29.000	9.000	4.739	1.471
3.	5	TUBITAK-MAM	29.000	8.000	4.739	1.307
4.	2	IBB	21.000	7.000	3.431	1.144
5.	20	PIU	21.000	0.000	3.431	0.000
6.	12	GDDA	17.000	2.000	2.778	0.327
7.	6	ITU-Cendm	15.000	0.000	2.451	0.000
8.	3	ITU	13.000	14.000	2.124	2.288
9.	35	GCM	13.000	3.000	2.124	0.490
10.	19	GDCD	11.000	2.000	1.797	0.327
11.	9	ERD	11.000	2.000	1.797	0.327
12.	7	TUBITAK	9.000	9.000	1.471	1.471
13.	10	Bu-Cendim	9.000	0.000	1.471	0.000
14.	33	TRAC	8.000	1.000	1.307	0.163
15.	26	Turkish Treasury	7.000	0.000	1.144	0.000
16.	56	Bolu Gov	6.000	0.000	0.980	0.000
17.	8	IPG	5.000	7.000	0.817	1.144
18.	21	SDC	5.000	1.000	0.817	0.163
19.	41	Kizilay-AFOM	5.000	0.000	0.817	0.000
20.	14	Ytu	4.000	4.000	0.654	0.654
21.	138	GDLRC	4.000	1.000	0.654	0.163
22.	27	KOU	3.000	3.000	0.490	0.490
23.	51	Izmir Municipality	2.000	0.000	0.327	0.000
24.	52	Bursa Municipality	2.000	0.000	0.327	0.000
25.	34	Duzce Mun.	1.000	1.000	0.163	0.163
26.	38	Sakarya Gov.	1.000	3.000	0.163	0.490
27.	40	Kizilay	1.000	4.000	0.163	0.654
28.	28	SAU	0.000	2.000	0.000	0.327
29.	11	BU	0.000	8.000	0.000	1.307
30.	17	District Municipalities	0.000	2.000	0.000	0.327
31.	4	METU	0.000	9.000	0.000	1.471
32.	32	AKUT	0.000	1.000	0.000	0.163
33.	24	FEMA	0.000	3.000	0.000	0.490
34.	25	Int. Ministry of Turkey	0.000	4.000	0.000	0.654
35.	16	JICA	0.000	4.000	0.000	0.654
36.	36	TFA	0.000	1.000	0.000	0.163
37.	37	Kocaeli Gov.	0.000	4.000	0.000	0.654
38.	29	NATO	0.000	3.000	0.000	0.490
39.	30	Firat Uni.	0.000	1.000	0.000	0.163
40.	31	MIT	0.000	4.000	0.000	0.654
41.	22	US Red Cross	0.000	1.000	0.000	0.163

		1	2	3	4
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
42.	42 UN	0.000	2.000	0.000	0.327
43.	15 Ist. Uni.	0.000	3.000	0.000	0.490
44.	44 SHOD	0.000	2.000	0.000	0.327
45.	45 DMI	0.000	1.000	0.000	0.163
46.	46 DSI	0.000	1.000	0.000	0.163
47.	47 MTA	0.000	4.000	0.000	0.654
48.	39 Yalova Gov.	0.000	1.000	0.000	0.163
49.	49 Avcilar Mun.	0.000	2.000	0.000	0.327
50.	50 Yalova Municipality	0.000	2.000	0.000	0.327
51.	13 GDTEM	0.000	3.000	0.000	0.490
52.	43 WB	0.000	4.000	0.000	0.654
53.	53 Kocaeli Mun.	0.000	1.000	0.000	0.163
54.	54 Sakarya Mun	0.000	1.000	0.000	0.163
55.	55 Bolu Mun	0.000	2.000	0.000	0.327
56.	18 District CMC	0.000	3.000	0.000	0.490
57.	48 DPT	0.000	1.000	0.000	0.163
58.	58 Afyon CD	0.000	1.000	0.000	0.163
59.	59 Adana CD	0.000	1.000	0.000	0.163
60.	60 Bursa CD	0.000	1.000	0.000	0.163
61.	23 Bursa Gov	0.000	2.000	0.000	0.327
62.	62 Erzurum CD	0.000	1.000	0.000	0.163
63.	63 Istanbul CD	0.000	1.000	0.000	0.163
64.	64 Izmir CD	0.000	1.000	0.000	0.163
65.	65 Sakarya CD	0.000	1.000	0.000	0.163
66.	66 Samsun CD	0.000	1.000	0.000	0.163
67.	67 Van CD	0.000	1.000	0.000	0.163
68.	68 GMG	0.000	1.000	0.000	0.163
69.	69 French Team	0.000	2.000	0.000	0.327
70.	70 TNGGA	0.000	2.000	0.000	0.327
71.	71 EUREF	0.000	1.000	0.000	0.163
72.	72 TEDAS	0.000	1.000	0.000	0.163
73.	73 Turk Telecom	0.000	1.000	0.000	0.163
74.	74 First Army Headquarters	0.000	1.000	0.000	0.163
75.	75 SAR	0.000	1.000	0.000	0.163
76.	57 Ankara CD	0.000	1.000	0.000	0.163
77.	77 SLF	0.000	1.000	0.000	0.163
78.	78 ETHZ-IGT	0.000	1.000	0.000	0.163
79.	79 EPFL-IS	0.000	1.000	0.000	0.163
80.	80 ETHZ-IG	0.000	1.000	0.000	0.163
81.	81 DRM	0.000	1.000	0.000	0.163
82.	82 TITech	0.000	1.000	0.000	0.163
83.	83 USGS	0.000	4.000	0.000	0.654
84.	84 USID-OFDA	0.000	1.000	0.000	0.163
85.	85 UNR	0.000	2.000	0.000	0.327
86.	86 UP	0.000	1.000	0.000	0.163
87.	87 IFRC	0.000	1.000	0.000	0.163
88.	88 Studer Engineering	0.000	1.000	0.000	0.163
89.	89 VT	0.000	1.000	0.000	0.163
90.	90 PSU	0.000	1.000	0.000	0.163
91.	91 WRMDC	0.000	2.000	0.000	0.327
92.	92 CNR	0.000	1.000	0.000	0.163
93.	93 NSSP	0.000	2.000	0.000	0.327
94.	94 Kyoto Uni	0.000	1.000	0.000	0.163
95.	95 DUTech	0.000	1.000	0.000	0.163
96.	96 LDEO	0.000	1.000	0.000	0.163
97.	97 LEL&OC-UK	0.000	1.000	0.000	0.163
98.	98 JIPE	0.000	2.000	0.000	0.327
99.	99 FJG	0.000	1.000	0.000	0.163
100.	100 Sumitomo Co.	0.000	1.000	0.000	0.163
101.	101 SSTL	0.000	1.000	0.000	0.163
102.	102 IRRS	0.000	2.000	0.000	0.327
103.	103 ING	0.000	2.000	0.000	0.327
104.	104 GII	0.000	1.000	0.000	0.163
105.	105 GI	0.000	2.000	0.000	0.327
106.	106 GPG	0.000	1.000	0.000	0.163
107.	107 IG-Tiblisi	0.000	2.000	0.000	0.327

		1	2	3	4
		OutDegree	InDegree	NrmOutDeg	NrmInDeg
108.	108 IG-Zurich	0.000	2.000	0.000	0.327
109.	109 IMG	0.000	1.000	0.000	0.163
110.	110 IRM	0.000	2.000	0.000	0.327
111.	111 IIEES	0.000	2.000	0.000	0.327
112.	112 IIEPTMG	0.000	2.000	0.000	0.327
113.	113 ISSMGE	0.000	1.000	0.000	0.163
114.	114 EAEE	0.000	1.000	0.000	0.163
115.	115 EIB	0.000	1.000	0.000	0.163
116.	116 GS&EEC	0.000	1.000	0.000	0.163
117.	117 ESA	0.000	1.000	0.000	0.163
118.	118 IS	0.000	2.000	0.000	0.327
119.	119 EUF	0.000	1.000	0.000	0.163
120.	120 EMGE	0.000	2.000	0.000	0.327
121.	121 ECC	0.000	1.000	0.000	0.163
122.	122 EIE	0.000	1.000	0.000	0.163
123.	123 Munich Regroup	0.000	1.000	0.000	0.163
124.	124 ERR	0.000	1.000	0.000	0.163
125.	125 Negro of JRC-Ispra	0.000	1.000	0.000	0.163
126.	126 CorlissWillis	0.000	1.000	0.000	0.163
127.	127 CAR	0.000	1.000	0.000	0.163
128.	128 CHRR	0.000	1.000	0.000	0.163
129.	129 CSFB	0.000	1.000	0.000	0.163
130.	130 Siemens	0.000	1.000	0.000	0.163
131.	131 Sika	0.000	1.000	0.000	0.163
132.	132 Unilever	0.000	1.000	0.000	0.163
133.	133 Turk Pirelli	0.000	1.000	0.000	0.163
134.	134 Erickson	0.000	1.000	0.000	0.163
135.	135 Tuncmatik	0.000	1.000	0.000	0.163
136.	136 YBT	0.000	1.000	0.000	0.163
137.	137 GFZ	0.000	2.000	0.000	0.327
138.	61 Diyarbakir CD	0.000	1.000	0.000	0.163
139.	139 CSIC-Spain	0.000	1.000	0.000	0.163
140.	140 ETHZ-Zurich	0.000	1.000	0.000	0.163
141.	141 GDI	0.000	1.000	0.000	0.163
142.	142 MPWS	0.000	2.000	0.000	0.327
143.	143 GDSL	0.000	1.000	0.000	0.163
144.	144 BS&TA	0.000	1.000	0.000	0.163
145.	145 DEU	0.000	2.000	0.000	0.327
146.	146 AIBU	0.000	1.000	0.000	0.163
147.	147 Zonguldak Karaelmas Uni.	0.000	1.000	0.000	0.163
148.	148 Dicle Uni	0.000	1.000	0.000	0.163
149.	149 Selcuk Uni.	0.000	1.000	0.000	0.163
150.	150 Karadeniz Uni.	0.000	1.000	0.000	0.163
151.	151 UNAVCO	0.000	2.000	0.000	0.327
152.	152 BKG	0.000	1.000	0.000	0.163
153.	153 Izmit KK	0.000	1.000	0.000	0.163
154.	154 Izmit CD	0.000	1.000	0.000	0.163

DESCRIPTIVE STATISTICS

	1	2	3	4
	OutDegree	InDegree	NrmOutDeg	NrmInDeg
1 Mean	1.831	1.831	0.299	0.299
2 Std Dev	5.393	1.937	0.881	0.316
3 Sum	282.000	282.000	46.078	46.078
4 Variance	29.088	3.751	0.777	0.100
5 SSQ	4996.000	1094.000	133.389	29.209
6 MCSSQ	4479.610	577.610	119.602	15.422
7 Euc Norm	70.682	33.076	11.549	5.405

Network Centralization (Outdegree) = 4.695%

Network Centralization (Indegree) = 2.028%

Table G- 2 Closeness Centrality Measures

			1	2
			Farness	nCloseness
			------------	------------
1.	1	BU-KOERI	341.000	44.868
2.	12	GDDA	361.000	42.382
3.	3	ITU	367.000	41.689
4.	5	TUBITAK-MAM	385.000	39.740
5.	2	IBB	394.000	38.832
6.	8	IPG	415.000	36.867
7.	20	PIU	417.000	36.691
8.	7	TUBITAK	426.000	35.915
9.	40	Kizilay	434.000	35.253
10.	4	METU	436.000	35.092
11.	35	GCM	438.000	34.932
12.	26	Turkish Treasury	440.000	34.773
13.	47	MTA	444.000	34.459
14.	33	TRAC	449.000	34.076
15.	50	Yalova Municipality	455.000	33.626
16.	11	BU	458.000	33.406
17.	31	MIT	458.000	33.406
18.	6	ITU-Cendm	461.000	33.189
19.	10	Bu-Cendim	462.000	33.117
20.	16	JICA	462.000	33.117
21.	76	ESC	463.000	33.045
22.	28	SAU	464.000	32.974
23.	9	ERD	466.000	32.833
24.	38	Sakarya Gov.	471.000	32.484
25.	37	Kocaeli Gov.	472.000	32.415
26.	21	SDC	474.000	32.278
27.	14	Ytu	475.000	32.211
28.	51	Izmir Municipality	482.000	31.743
29.	83	USGS	485.000	31.546
30.	29	NATO	485.000	31.546
31.	41	Kizilay-AFOM	489.000	31.288
32.	27	KOU	491.000	31.161
33.	129	CSFB	493.000	31.034
34.	116	GS&EEC	493.000	31.034
35.	56	Bolu Gov	493.000	31.034
36.	72	TEDAS	493.000	31.034
37.	74	First Army Headquarters	493.000	31.034
38.	123	Munich Regroup	493.000	31.034
39.	113	ISSMGE	493.000	31.034
40.	22	US Red Cross	493.000	31.034
41.	125	Negro of JRC-Ispra	493.000	31.034
42.	73	Turk Telecom	493.000	31.034
43.	114	EAEE	493.000	31.034
44.	75	SAR	493.000	31.034
45.	43	WB	494.000	30.972
46.	15	Ist. Uni.	494.000	30.972
47.	91	WRMDC	500.000	30.600
48.	19	GDCD	511.000	29.941
49.	81	DRM	513.000	29.825
50.	80	ETHZ-IG	513.000	29.825
51.	88	Studer Engineering	513.000	29.825
52.	79	EPFL-IS	513.000	29.825
53.	78	ETHZ-IGT	513.000	29.825
54.	89	VT	513.000	29.825
55.	86	UP	513.000	29.825
56.	77	SLF	513.000	29.825
57.	133	Turk Pirelli	519.000	29.480
58.	117	ESA	519.000	29.480
59.	134	Erickson	519.000	29.480
60.	136	YBT	519.000	29.480

			1	2
			Farness	nCloseness
61.	132	Unilever	519.000	29.480
62.	131	Sika	519.000	29.480
63.	130	Siemens	519.000	29.480
64.	135	Tuncmatik	519.000	29.480
65.	13	GDTEM	527.000	29.032
66.	49	Avcilar Mun.	529.000	28.922
67.	70	TNGGA	531.000	28.814
68.	151	UNAVCO	531.000	28.814
69.	55	Bolu Mun	535.000	28.598
70.	82	TITech	537.000	28.492
71.	69	French Team	537.000	28.492
72.	71	EUREF	537.000	28.492
73.	30	Firat Uni.	537.000	28.492
74.	44	SHOD	537.000	28.492
75.	119	EUF	537.000	28.492
76.	68	GMG	537.000	28.492
77.	138	GDLRC	539.000	28.386
78.	17	District Municipalities	546.000	28.022
79.	99	FJG	546.000	28.022
80.	109	IMG	546.000	28.022
81.	92	CNR	546.000	28.022
82.	96	LDEO	546.000	28.022
83.	34	Duzce Mun.	567.000	26.984
84.	18	District Crisis Management Center	567.000	26.984
85.	54	Sakarya Mun	569.000	26.889
86.	141	GDI	569.000	26.889
87.	143	GDSL	569.000	26.889
88.	122	EIE	569.000	26.889
89.	115	EIB	569.000	26.889
90.	46	DSI	569.000	26.889
91.	142	MPWS	569.000	26.889
92.	45	DMI	569.000	26.889
93.	106	GPG	569.000	26.889
94.	121	ECC	569.000	26.889
95.	124	ERR	569.000	26.889
96.	145	DEU	570.000	26.842
97.	42	UN	575.000	26.609
98.	104	GII	578.000	26.471
99.	101	SSTL	578.000	26.471
100.	150	Karadeniz Uni.	590.000	25.932
101.	149	Selcuk Uni.	590.000	25.932
102.	152	BKG	590.000	25.932
103.	148	Dicle Uni	590.000	25.932
104.	126	CorlissWillis	592.000	25.845
105.	97	LEL&OC-UK	592.000	25.845
106.	127	CAR	592.000	25.845
107.	23	Bursa Gov	597.000	25.628
108.	87	IFRC	601.000	25.458
109.	100	Sumitomo Co.	613.000	24.959
110.	36	TFA	613.000	24.959
111.	24	FEMA	613.000	24.959
112.	25	Interior Ministry of Turkey	613.000	24.959
113.	32	AKUT	613.000	24.959
114.	84	USID-OFDA	614.000	24.919
115.	128	CHRR	614.000	24.919
116.	140	ETHZ-Zurich	615.000	24.878
117.	137	GFZ	615.000	24.878
118.	118	IS	615.000	24.878
119.	139	CSIC-Spain	615.000	24.878
120.	120	EMGE	615.000	24.878
121.	102	IRRS	615.000	24.878
122.	103	ING	615.000	24.878
123.	105	GI	615.000	24.878
124.	112	IIEPTMG	615.000	24.878

			1	2
			Farness	nCloseness
125.	110	IRM	615.000	24.878
126.	98	JIPE	615.000	24.878
127.	108	IG-Zurich	615.000	24.878
128.	107	IG-Tiblisi	615.000	24.878
129.	93	NSSP	615.000	24.878
130.	111	IIEES	615.000	24.878
131.	85	UNR	618.000	24.757
132.	154	Izmit CD	626.000	24.441
133.	153	Izmit KK	626.000	24.441
134.	53	Kocaeli Mun.	626.000	24.441
135.	95	DUTech	627.000	24.402
136.	48	DPT	643.000	23.795
137.	90	PSU	643.000	23.795
138.	144	BS&TA	645.000	23.721
139.	146	AIBU	645.000	23.721
140.	61	Diyarbakir CD	663.000	23.077
141.	58	Afyon CD	663.000	23.077
142.	65	Sakarya CD	663.000	23.077
143.	62	Erzurum CD	663.000	23.077
144.	67	Van CD	663.000	23.077
145.	59	Adana CD	663.000	23.077
146.	60	Bursa CD	663.000	23.077
147.	63	Istanbul CD	663.000	23.077
148.	66	Samsun CD	663.000	23.077
149.	57	Ankara CD	663.000	23.077
150.	64	Izmir CD	663.000	23.077
151.	39	Yalova Gov.	691.000	22.142
152.	94	Kyoto Uni	719.000	21.280
153.	52	Bursa Municipality	747.000	20.482
154.	147	Zonguldak Karaelmas Uni.	899.000	17.019

Statistics

		1	2
		Farness	nCloseness
		------------	------------
1	Mean	549.779	28.448
2	Std Dev	80.690	4.337
3	Sum	84666.000	4380.983
4	Variance	6510.847	18.811
5	SSQ	47550280.000	127526.906
6	MCSSQ	1002670.500	2896.943
7	Euc Norm	6895.671	357.109
8	Minimum	341.000	17.019
9	Maximum	899.000	44.868

Network Centralization = 33.44%

Table G- 3 Betweenness Centrality Measures

			1	2
			Betweenness	nBetweenness
			------------	------------
1.	1	BU-KOERI	538.767	2.317
2.	3	ITU	417.700	1.796
3.	5	TUBITAK-MAM	413.700	1.779
4.	7	TUBITAK	323.283	1.390
5.	2	IBB	180.583	0.777
6.	12	GDDA	156.500	0.673
7.	35	GCM	141.117	0.607
8.	27	KOU	105.000	0.451
9.	8	IPG	98.333	0.423
10.	14	Ytu	42.067	0.181
11.	19	GDCD	33.000	0.142
12.	9	ERD	31.450	0.135
13.	40	Kizilay	20.000	0.086
14.	21	SDC	18.000	0.077
15.	33	TRAC	18.000	0.077
16.	38	Sakarya Gov.	5.000	0.021
17.	138	GDLRC	2.500	0.011
18.	34	Duzce Mun.	1.000	0.004
19.	10	Bu-Cendim	0.000	0.000
20.	11	BU	0.000	0.000
21.	17	District Municipalities	0.000	0.000
22.	13	GDTEM	0.000	0.000
23.	4	METU	0.000	0.000
24.	6	ITU-Cendm	0.000	0.000
25.	25	Interior Ministry of Turkey	0.000	0.000
26.	26	Turkish Treasury	0.000	0.000
27.	18	District Crisis Management Center	0.000	0.000
28.	28	SAU	0.000	0.000
29.	20	PIU	0.000	0.000
30.	30	Firat Uni.	0.000	0.000
31.	22	US Red Cross	0.000	0.000
32.	32	AKUT	0.000	0.000
33.	24	FEMA	0.000	0.000
34.	15	Ist. Uni.	0.000	0.000
35.	16	JICA	0.000	0.000
36.	36	TFA	0.000	0.000
37.	37	Kocaeli Gov.	0.000	0.000
38.	29	NATO	0.000	0.000
39.	39	Yalova Gov.	0.000	0.000
40.	31	MIT	0.000	0.000
41.	41	Kizilay-AFOM	0.000	0.000
42.	42	UN	0.000	0.000
43.	43	WB	0.000	0.000
44.	44	SHOD	0.000	0.000
45.	45	DMI	0.000	0.000
46.	46	DSI	0.000	0.000
47.	47	MTA	0.000	0.000
48.	48	DPT	0.000	0.000
49.	49	Avcilar Mun.	0.000	0.000
50.	50	Yalova Municipality	0.000	0.000
51.	51	Izmir Municipality	0.000	0.000
52.	52	Bursa Municipality	0.000	0.000
53.	53	Kocaeli Mun.	0.000	0.000
54.	54	Sakarya Mun	0.000	0.000
55.	55	Bolu Mun	0.000	0.000
56.	56	Bolu Gov	0.000	0.000
57.	57	Ankara CD	0.000	0.000
58.	58	Afyon CD	0.000	0.000
59.	59	Adana CD	0.000	0.000
60.	60	Bursa CD	0.000	0.000

		1	2
		Betweenness	nBetweenness
61.	23 Bursa Gov	0.000	0.000
62.	62 Erzurum CD	0.000	0.000
63.	63 Istanbul CD	0.000	0.000
64.	64 Izmir CD	0.000	0.000
65.	65 Sakarya CD	0.000	0.000
66.	66 Samsun CD	0.000	0.000
67.	67 Van CD	0.000	0.000
68.	68 GMG	0.000	0.000
69.	69 French Team	0.000	0.000
70.	70 TNGGA	0.000	0.000
71.	71 EUREF	0.000	0.000
72.	72 TEDAS	0.000	0.000
73.	73 Turk Telecom	0.000	0.000
74.	74 First Army Headquarters	0.000	0.000
75.	75 SAR	0.000	0.000
76.	76 ESC	0.000	0.000
77.	77 SLF	0.000	0.000
78.	78 ETHZ-IGT	0.000	0.000
79.	79 EPFL-IS	0.000	0.000
80.	80 ETHZ-IG	0.000	0.000
81.	81 DRM	0.000	0.000
82.	82 TITech	0.000	0.000
83.	83 USGS	0.000	0.000
84.	84 USID-OFDA	0.000	0.000
85.	85 UNR	0.000	0.000
86.	86 UP	0.000	0.000
87.	87 IFRC	0.000	0.000
88.	88 Studer Engineering	0.000	0.000
89.	89 VT	0.000	0.000
90.	90 PSU	0.000	0.000
91.	91 WRMDC	0.000	0.000
92.	92 CNR	0.000	0.000
93.	93 NSSP	0.000	0.000
94.	94 Kyoto Uni	0.000	0.000
95.	95 DUTech	0.000	0.000
96.	96 LDEO	0.000	0.000
97.	97 LEL&OC-UK	0.000	0.000
98.	98 JIPE	0.000	0.000
99.	99 FJG	0.000	0.000
100.	100 Sumitomo Co.	0.000	0.000
101.	101 SSTL	0.000	0.000
102.	102 IRRS	0.000	0.000
103.	103 ING	0.000	0.000
104.	104 GII	0.000	0.000
105.	105 GI	0.000	0.000
106.	106 GPG	0.000	0.000
107.	107 IG-Tiblisi	0.000	0.000
108.	108 IG-Zurich	0.000	0.000
109.	109 IMG	0.000	0.000
110.	110 IRM	0.000	0.000
111.	111 IIEES	0.000	0.000
112.	112 IIEPTMG	0.000	0.000
113.	113 ISSMGE	0.000	0.000
114.	114 EAEE	0.000	0.000
115.	115 EIB	0.000	0.000
116.	116 GS&EEC	0.000	0.000
117.	117 ESA	0.000	0.000
118.	118 IS	0.000	0.000
119.	119 EUF	0.000	0.000
120.	120 EMGE	0.000	0.000
121.	121 ECC	0.000	0.000
122.	122 EIE	0.000	0.000
123.	123 Munich Regroup	0.000	0.000
124.	124 ERR	0.000	0.000

			1	2
			Betweenness	nBetweenness
125.	125	Negro of JRC-Ispra	0.000	0.000
126.	126	CorlissWillis	0.000	0.000
127.	127	CAR	0.000	0.000
128.	128	CHRR	0.000	0.000
129.	129	CSFB	0.000	0.000
130.	130	Siemens	0.000	0.000
131.	131	Sika	0.000	0.000
132.	132	Unilever	0.000	0.000
133.	133	Turk Pirelli	0.000	0.000
134.	134	Erickson	0.000	0.000
135.	135	Tuncmatik	0.000	0.000
136.	136	YBT	0.000	0.000
137.	137	GFZ	0.000	0.000
138.	61	Diyarbakir CD	0.000	0.000
139.	139	CSIC-Spain	0.000	0.000
140.	140	ETHZ-Zurich	0.000	0.000
141.	141	GDI	0.000	0.000
142.	142	MPWS	0.000	0.000
143.	143	GDSL	0.000	0.000
144.	144	BS&TA	0.000	0.000
145.	145	DEU	0.000	0.000
146.	146	AIBU	0.000	0.000
147.	147	Zonguldak Karaelmas Uni.	0.000	0.000
148.	148	Dicle Uni	0.000	0.000
149.	149	Selcuk Uni.	0.000	0.000
150.	150	Karadeniz Uni.	0.000	0.000
151.	151	UNAVCO	0.000	0.000
152.	152	BKG	0.000	0.000
153.	153	Izmit KK	0.000	0.000
154.	154	Izmit CD	0.000	0.000

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1	2
		Betweenness	nBetweenness
		------------	------------
1	Mean	16.532	0.071
2	Std Dev	72.118	0.310
3	Sum	2546.000	10.948
4	Variance	5200.973	0.096
5	SSQ	843041.500	15.588
6	MCSSQ	800949.875	14.809
7	Euc Norm	918.173	3.948
8	Minimum	0.000	0.000
9	Maximum	538.767	2.317

Network Centralization Index = 2.24%

Table G- 4 Flow Betweenness Centrality Measures

			1	2
			FlowBet	nFlowBet
			------------	------------
1.	1	BU-KOERI	916.077	3.939
2.	3	ITU	363.852	1.565
3.	5	TUBITAK-MAM	331.182	1.424
4.	7	TUBITAK	219.336	0.943
5.	2	IBB	135.064	0.581
6.	8	IPG	117.292	0.504
7.	27	KOU	107.976	0.464
8.	35	GCM	101.755	0.438
9.	12	GDDA	77.333	0.333
10.	9	ERD	69.743	0.3
11.	14	Ytu	42.142	0.181
12.	33	TRAC	11.333	0.049
13.	21	SDC	4.833	0.021
14.	138	GDLRC	1.333	0.006
15.	34	Duzce Mun.	1	0.004
16.	38	Sakarya Gov.	1	0.004
17.	40	Kizilay	1	0.004
18.	11	BU	0	0
19.	4	METU	0	0
20.	6	ITU-Cendm	0	0
21.	10	Bu-Cendim	0	0
22.	13	GDTEM	0	0
23.	15	Ist. Uni.	0	0
24.	16	JICA	0	0
25.	17	District Municipalities	0	0
26.	18	District Crisis Management Center	0	0
27.	19	GDCD	0	0
28.	20	PIU	0	0
29.	22	US Red Cross	0	0
30.	23	Bursa Gov	0	0
31.	24	FEMA	0	0
32.	25	Interior Ministry of Turkey	0	0
33.	26	Turkish Treasury	0	0
34.	28	SAU	0	0
35.	29	NATO	0	0
36.	30	Firat Uni.	0	0
37.	31	MIT	0	0
38.	32	AKUT	0	0
39.	36	TFA	0	0
40.	37	Kocaeli Gov.	0	0
41.	39	Yalova Gov.	0	0
42.	41	Kizilay-AFOM	0	0
43.	42	UN	0	0
44.	43	WB	0	0
45.	44	SHOD	0	0
46.	45	DMI	0	0
47.	46	DSI	0	0
48.	47	MTA	0	0
49.	48	DPT	0	0
50.	49	Avcilar Mun.	0	0
51.	50	Yalova Municipality	0	0
52.	51	Izmir Municipality	0	0
53.	52	Bursa Municipality	0	0
54.	53	Kocaeli Mun.	0	0
55.	54	Sakarya Mun	0	0
56.	55	Bolu Mun	0	0
57.	56	Bolu Gov	0	0
58.	57	Ankara CD	0	0
59.	58	Afyon CD	0	0

			1	2
			FlowBet	nFlowBet
60.	59	Adana CD	0	0
61.	60	Bursa CD	0	0
62.	61	Diyarbakir CD	0	0
63.	62	Erzurum CD	0	0
64.	63	Istanbul CD	0	0
65.	64	Izmir CD	0	0
66.	65	Sakarya CD	0	0
67.	66	Samsun CD	0	0
68.	67	Van CD	0	0
69.	68	GMG	0	0
70.	69	French Team	0	0
71.	70	TNGGA	0	0
72.	71	EUREF	0	0
73.	72	TEDAS	0	0
74.	73	Turk Telecom	0	0
75.	74	First Army Headquarters	0	0
76.	75	SAR	0	0
77.	76	ESC	0	0
78.	77	SLF	0	0
79.	78	ETHZ-IGT	0	0
80.	79	EPFL-IS	0	0
81.	80	ETHZ-IG	0	0
82.	81	DRM	0	0
83.	82	TITech	0	0
84.	83	USGS	0	0
85.	84	USID-OFDA	0	0
86.	85	UNR	0	0
87.	86	UP	0	0
88.	87	IFRC	0	0
89.	88	Studer Engineering	0	0
90.	89	VT	0	0
91.	90	PSU	0	0
92.	91	WRMDC	0	0
93.	92	CNR	0	0
94.	93	NSSP	0	0
95.	94	Kyoto Uni	0	0
96.	95	DUTech	0	0
97.	96	LDEO	0	0
98.	97	LEL&OC-UK	0	0
99.	98	JIPE	0	0
100.	99	FJG	0	0
101.	100	Sumitomo Co.	0	0
102.	101	SSTL	0	0
103.	102	IRRS	0	0
104.	103	ING	0	0
105.	104	GII	0	0
106.	105	GI	0	0
107.	106	GPG	0	0
108.	107	IG-Tiblisi	0	0
109.	108	IG-Zurich	0	0
110.	109	IMG	0	0
111.	110	IRM	0	0
112.	111	IIEES	0	0
113.	112	IIEPTMG	0	0
114.	113	ISSMGE	0	0
115.	114	EAEE	0	0
116.	115	EIB	0	0
117.	116	GS&EEC	0	0
118.	117	ESA	0	0
119.	118	IS	0	0
120.	119	EUF	0	0
121.	120	EMGE	0	0
122.	121	ECC	0	0
123.	122	EIE	0	0
124.	123	Munich Regroup	0	0
125.	124	ERR	0	0

			1	2
			FlowBet	nFlowBet
126.	125	Negro of JRC-Ispra	0	0
127.	126	CorlissWillis	0	0
128.	127	CAR	0	0
129.	128	CHRR	0	0
130.	129	CSFB	0	0
131.	130	Siemens	0	0
132.	131	Sika	0	0
133.	132	Unilever	0	0
134.	133	Turk Pirelli	0	0
135.	134	Erickson	0	0
136.	135	Tuncmatik	0	0
137.	136	YBT	0	0
138.	137	GFZ	0	0
139.	139	CSIC-Spain	0	0
140.	140	ETHZ-Zurich	0	0
141.	141	GDI	0	0
142.	142	MPWS	0	0
143.	143	GDSL	0	0
144.	144	BS&TA	0	0
145.	145	DEU	0	0
146.	146	AIBU	0	0
147.	147	Zonguldak Karaelmas Uni.	0	0
148.	148	Dicle Uni	0	0
149.	149	Selcuk Uni.	0	0
150.	150	Karadeniz Uni.	0	0
151.	151	UNAVCO	0	0
152.	152	BKG	0	0
153.	153	Izmit KK	0	0
154.	154	Izmit CD	0	0

Network Centralization Index = 3.895%

DESCRIPTIVE STATISTICS FOR EACH MEASURE

		1	2
		FlowBet	nFlowBet
1	Mean	16.248	0.070
2	Std Dev	86.622	0.372
3	Sum	2502.252	10.760
4	Variance	7503.299	0.139
5	SSQ	1196165.750	22.117
6	MCSSQ	1155508.125	21.365
7	Euc Norm	1093.694	4.703

APPENDIX H

LIST OF ORGANIZATION INVOLVED IN PROJECTS

No:	Name of Organizations	Source of Funding & Jurisdictions
1.	Bogazici University, Kandilli Observatory and Earthquake Research Institute (BU-KOERI)	Public-central
2.	Istanbul Technical University (ITU)	Public-central
3.	Middle East Technical University (METU)	Public-central
4.	TUBITAK Marmara Research Center (TUBITAK-MAM)	Public-central
5.	ITU Center of Excellence for Disaster Management (ITU-CEDM)	Public-central
6.	GDDA Earthquake Research Center (ERD)	Public-central
7.	The Scientific and Technical research and Council Turkey (TUBITAK)	Public-central
8.	Bogazici University-Center for Disaster Management (BU-CENDIM)	Public-central
9.	General Directorate of Turkish Disaster Affairs (GDDA)	Public-central
10.	General Directorate of Turkey Emergency Management (GDTEM)	Public-central
11.	Bogazici University	Public-central
12.	Yildiz Technical University (YTU)	Public-central
13.	Istabul University (IU)	Public-central
14.	General Directorate of Civil Defense (GDCD)	Public-central
15.	Republic of Turkey Prime Ministry Project Implementation Unit (PIU)	Public-central
16.	Ege University (EU)	Public-central
17.	Interior Ministry of Turkey	Public-central
18.	Kocaeli University (KOU)	Public-central
19.	Sakarya University (SAU)	Public-central

No:	Name of Organizations	Source of Funding & Jurisdictions
20.	Firat University, (FU)	Public-central
21.	General Command of Mapping, Turkey (GCM)	Public-central
22.	Turkish Navy- Department of Navigation, Hydrography and Oceanography, (SHOD)	Public-central
23.	Central Meteorological Affairs (DMI)	Public-central
24.	General Directorates of Central Hydraulic Works (DSI)	Public-central
25.	General Directorate of Mineral Research and Exploration (MTA)	Public-central
26.	Central Planning Institution	Public-central
27.	Turkish Central Electricity Distribution Corp	Public-central
28.	Turk Telecom	Public-central
29.	General Directorate of Electrical Power Resources, Turkey	Public-central
30.	General Directorate of Land Registry and Cadastre (GDLRC)	Public-central
31.	General Directorate of Insurance (GDI)	Public-central
32.	Ministry of Public Works and Settlements (MPWS)	Public-central
33.	General Directorate of Central Land (GDSL)	Public-central
34.	Dokuz Eylul University	Public-central
35.	Abant Izzet Baysal University	Public-central
36.	Zonguldak Karaelmas Uni.	Public-central
37.	Dicle Uni	Public-central
38.	Selcuk Uni.	Public-central
39.	Karadeniz Uni.	Public-central
40.	First Army Headquarters	Public-central
41.	Istanbul Province Government, (IPG)	Public-province
42.	Kocaeli Government	Public-province
43.	Sakarya Government	Public-province
44.	Yalova Government	Public-province
45.	Bolu Gov	Public-province
46.	Duzce Province Government, (DG)	Public-province
47.	Ankara Civil Defense (CD)	Public-province
48.	Afyon CD	Public-province
49.	Adana CD	Public-province
50.	Bursa CD	Public-province
51.	Diyarbakir CD	Public-province
52.	Erzurum CD	Public-province
53.	Istanbul CD	Public-province
54.	Izmir CD	Public-province
55.	Sakarya CD	Public-province

No:	Name of Organizations	Source of Funding & Jurisdictions
56.	Samsun CD	Public-province
57.	Van CD	Public-province
58.	Search and Rescue (SAR)	Public-province
59.	Izmit Kent Kurultayi	Public-Province
60.	Izmit Civil Defense	Public-Province
61.	Istanbul Metropolitan Municipality (IBB)	Municipality
62.	Yalova Municipality	Municipality
63.	Izmir Municipality	Municipality
64.	Bursa Municipality	Municipality
65.	Kocaeli Mun.	Municipality
66.	Sakarya Mun	Municipality
67.	Bolu Mun	Municipality
68.	Duzce Municipality	Municipality
69.	Avcilar Municipality	Municipality
70.	Diztrict Municipalities	Public-district (Municipality)
71.	District Crisis Management Center	Public Disctrict
72.	Siemens	Private
73.	Sika	Private
74.	Unilever	Private
75.	Turk Pirelli	Private
76.	Erickson	Private
77.	Tuncmatik	Private
78.	Yapisal Tasarim Hizmetleri (YBT)	Private
79.	Turkish Ameteur Radio Club	National Nonprofit
80.	Search and Rescue Association (AKUT)	National Nonprofit
81.	Turkish Firebrigade Association (TFA)	National Nonprofit
82.	Turkish Red Crescent Society (KIZILAY)	National Nonprofit
83.	Kizilay-Emergency Coordination Center	National Nonprofit
84.	Turkish National Geophysics and Geodesy Association	National Nonprofit
85.	Bolu Industrial and Trade Association	National Nonprofit
86.	Swiss Agency for Development and Cooperation (SDC)	International Public
87.	Federal Emergency Management Agency, USA (FEMA)	International Public
88.	North Atlantic Treaty Organization (NATO)	International Public
89.	Gumulcine Municipality of Greece (GMG)	International Public
90.	Swiss Federal Institute of Snow and Avalanche Research (SLF)	International Public
91.	Swiss Federal Institute of Technology Zurich - Institute for Geotechnical Engineering (ETHZ-IGT)	International Public
92.	Swiss Federal Institute Technology Lausanne (EPFL-IS)	International Public
93.	Swiss Federal Institute Technology Zurich (ETHZ_IG)	International Public
94.	United Centrals Geological Survey (USGS)	International Public

No:	Name of Organizations	Source of Funding & Jurisdictions
95.	United Centrals International Development Agency "Office of Foreign Disaster Assistance" (USID-OFDA)	International Public
96.	Penn Central University	International Public
97.	National Research Council of Italy (CNR)	International Public
98.	National Survey for Seismic Protection, Yerevan, Armenia (NSSP)	International Public
99.	Darmstadt University of Tech.-Institute of Physics and Geodesy	International Public
100.	Joint Institute of Physics of the Earth, Moscow, Russia (JIPE)	International Public
101.	Julich Research Center	International Public
102.	Istituto di Ricerca sul Rischio Sismico, Milano, Italy IRRS)	International Public
103.	Istituto Nazionale di Geofisica, Roma, Italy (ING)	International Public
104.	Geophysical Institute of Israel (GII)	International Public
105.	Geophysics Institute, National Academy of Sciences, Kiev, Ukraine (GI)	International Public
106.	Grevena Province Government, Greece (GPG)	International Public
107.	Institute of Geophysics, Academy of Sciences, Tbilisi, Georgia (IG,Tblisi)	International Public
108.	Institute of Geophysics, ETH Zurich, Switzerland (IG,Zurich)	International Public
109.	Institute of Marine Geology, Italy (IMG)	International Public
110.	Institute of Rock Mechanics, Academy of Sciences, Prague, Czech Republic (IRM)	International Public
111.	International Institute of Earthquake Engineering and Seismology, Teheran, Iran (IIEES)	International Public
112.	International Institute of Earthquake Prediction Theory and Mathematical Geophysics, Moscow, Russia (IIEPTMG)	International Public
113.	Institute of Seismology, Academy of Sciences, Ashkhabad, Turkmenistan (IS)	International Public
114.	Experimental Methodical Geophysical Expedition, Academy of Sciences, Baku, Azerbaijan (EMGE)	International Public
115.	Emilia Romagna Region, Italy (ERR)	International Public
116.	GeoForschungsZentrum, Potsdam, Germany (GFZ)	International Public
117.	Consejo Superior de Investigaciones Cientificas-Spain	International Public
118.	Swiss Seismological Service, ETHZ-Zurich	International Public
119.	Bundesamt Kartographie und Geodasie (BKG)	International Public
120.	Japan International Cooperation Agency (JICA)	International Nonprofit
121.	US Red Cross	International Nonprofit
122.	Massachusetts Institute of Technology	International Nonprofit
123.	United Nations	International Nonprofit
124.	World Bank	International Nonprofit
125.	French Team	International Nonprofit
126.	European Reference Frame	International Nonprofit

No:	Name of Organizations	Source of Funding & Jurisdictions
127.	European Seismological Commission	International Nonprofit
128.	The world Institue for Disaster management (DRM)	International Nonprofit
129.	Tokyo Institute of Technology, (TITech)	International Nonprofit
130.	University of Nevada at Reno (UNR)	International Nonprofit
131.	University of PA (UP)	International Nonprofit
132.	International Federation of Red Cross	International Nonprofit
133.	Virginia Institute of Technology (VT)	International Nonprofit
134.	Wharton Risk Management and Decision Center (WRMDC)	International Nonprofit
135.	Kyoto University	International Nonprofit
136.	Lamont-Doherty Earth Observatory, Colombia University (LDEO)	International Nonprofit
137.	International Society of Soil Mechanics and Geotechnical Engineering (ISSMGE)	International Nonprofit
138.	European Association of Earthquake Engineering (EAEE)	International Nonprofit
139.	European Investment Bank (EIB)	International Nonprofit
140.	European Space Agency (ESA)	International Nonprofit
141.	European Union Fund (EUF)	International Nonprofit
142.	Environmental Institute for Health and Consumer Protection (Negro of JRC-Ispra)	International Nonprofit
143.	Center for Hazard and Risk Research- Colombia University (CHRR)	International Nonprofit
144.	University NAVSTAR Consortium (UNAVCO)	International Nonprofit
145.	Surrey Satellite Technology Limited	International Private
146.	GeoSig&Electrowatt Ekono Cons	International Private
147.	Exandas Consultant Comp.(ECC)	International Private
148.	Munich Regroup	International Private
149.	Corliss Willis	International Private
150.	Cambridge Architectural Research Limited (CAR)	International Private
151.	Credit Suisse First Boston (CSFB)	International Private
152.	Studer Engineering	International Private
153.	London Economics Limited and Oracle Corporation UK Ltd (LEL&OC-UK)	International Private
154.	Sumitomo Co.	International Private

APPENDIX I

JOINT PROJECTS

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
2001	1	1.1	BU-KOERI	Strong Ground Motion	Earthquake Monitoring and Recording	38 digital accelerometers are added to Strong Ground Motion Network	Public-Central	ERD	http://www.koeri.boun.edu.tr/depremmuh/
2002	1	1.2	BU-KOERI	Istanbul Earthquake Rapid Response and Early Warning Project	Earthquake Prediction	110 station were installed	Public-Central	IPG, First Army Headquarters, IBB, (CSFB), GeoSig&Electrowatt Ekono Cons	http://www.koeri.boun.edu.tr/depremmuh/ & Report by Mustafa Erdik "Strong Data Acquisition, Processing and Utilization in Turkey
1999-2000	1	1.3	BU-KOERI	NATO Science for Peace project	Earthquake-loss Assessment	A comprehensive investigation of earthquake loss in Istanbul	Public-Central	NATO	http://www.koeri.boun.edu.tr/depremmuh/
2000-2001	1	1.4	BU-KOERI	KOERI-Loss software	Earthquake-loss Assessment	a GIS program is developed	Public-Central	SAR agencies, IBB, IPG	The Same
	1	1.5	BU-KOERI	Seismic Microzonation	Risk Assessment	served on the technical committee and in the preparation of manual for zonation on seismic geotechnical hazard	Public-Central	ISSMGE	The Same
2004-2006	1	1.6	BU-KOERI	Performance Based Seismic Evaluation and Design	Civil Engineering	testing a nonlinear analysis techniques "being developed for the performance evaluation of existing structures and the design of new structures under the action of seismic ground motion"	Public-Central	(EAEE), Negro of JRC-Ispra	The Same

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
2002	1	1.7	BU-KOERI	Earthquake Risk Assessments for Istanbul Metropolitan Area	Earthquake Scenario and Plan	earthquake risk is investigated and loss-estimation models are developed for the metropolitan area of Istanbul	Public-Central	The US Red Cross, KIZILAY, IBB, IPG,TEDAS, Turk Telekom, USGS, Munich-Re Group	The Same
2002	1	1.8	BU-KOERI	Earthquake Risk Assessments for industrial facilities in Istanbul	Earthquake Scenario and Plan	earthquake risk is investigated for the industrial facilities in Istanbul	Public-Central	Munich Re Group	The Same
2003-	1	1.9	BU-KOERI	Investigation of Total Displacement in the Western Part of North Anatolian Fault Zone Using GPS Technology	Mitigation Geodesy	a new geodetic network with 10 stations in Iznik is measured using GPS technology	Public-Central	GCM	The Same
2003-	1	1.10	BU-KOERI	Monitoring Tectonic Deformations by Geodetic Measurements Techniques	Mitigation Geodesy	Terrestrial techniques and GPS are performed on the networks on the North Anatolian Fault Zone and the results are compared.	Public-Central	Bogaziçi University	The Same
2001-2003	1	1.11	BU-KOERI	Post seismic Deformation Following the 1999 Izmit-Duzce Earthquake GPS studies	Mitigation Geodesy	Seismic deformation after 1999 Earthquakes are investigated by GPS	Public-Central	MIT, GCM, ITU, TUBITAK	The Same
2002-2003	1	1.12	BU-KOERI	Monitoring Crustal Deformation by Different Geodetic Measurement Techniques	Mitigation Geodesy	Crustal Deformation are monitored after the 1999 Earthquakes by using geodetic techniques	Public-Central	Bogaziçi University	The Same
2000-2001	1	1.13	BU-KOERI	Investigation of Pre/Co/Post Seismic Displacement in Iznik, Sapanca, Akyazi Using GPS Technology	Mitigation Geodesy	Pre and post seismic movement are being investigated by GPS	Public-Central	Bogaziçi University	The Same
January 2001-Spring 2005	10	10.1	BU-CENDIM	Automated Decision-Support for Logistics Operations in Disaster Relief Operations using Helicopters	Emergency Response	the development of an automated decision support framework for planning the deployment of helicopters in disaster relief operations	Public-Central	NATO	http://www.cendim.boun.edu.tr/
June 2001-January 2003	10	10.2	BU-CENDIM	Authority and Communication Systems for Disaster Management: An Integrated Model	Information Management	developing an authority and communications structure for policy formulation, decision making and coordination for disaster preparation and response for the Istanbul area	Public-Central	Bogaziçi University	The same
July 2002-April 2003	10	10.3	BU-CENDIM	Disaster Management Database Design and Implementation Project for Istanbul	Information Management	creating a database to use during disaster relief operations	Public-Central	IPG	The same
February 2002-June 2002	10	10.4	BU-CENDIM	Benefit Cost Analysis of Mitigation Strategies for Apartment Buildings in Turkey	Civil engineering	developing different modules and set different measurements for constructing the buildings for different earthquake scenarios	Public-Central	CHRR, BU-KOERI, (WRMDC)	The Same

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
December 2000-December 2003	10	10.5	BU-CENDIM	Integrated Decision Support System for Disaster Management in Turkey	Information Management	enhancing the EM and humanitarian relief capability of disaster by focusing on preparedness and response strategies for potential major earthquakes in the Metropolitan City Istanbul	Public-Central	Bogaziçi University	The Same
October 2001-September 2003	10	10.6	BU-CENDIM	Istanbul Disaster Preparedness Education Project	Information Management	increase emergency awareness, developing GIS project to integrate disaster capability with USGS, crating web-site for information sharing	Public-Central	(USID-OFDA), USGS	The Same
2000-	2	2.1	IBB	The Study on Disaster Prevention, Mitigation Basic Plan in Istanbul including Seismic Microzonation in the Republic of Turkey	Risk Assessment	creating seismic Microzonation maps, collecting Microzonation data studies, and creating a database for land use management	Public-provincial	JICA, IPG	http://www.jica.go.jp/turkey http://www.ibb.gov.tr/ibbtr/144/14405/2001/01/220101.htm
2002-2003	2	2.2	IBB	Earthquake Master plan for Istanbul	Risk Assessment	A comprehensive analysis/outline for Istanbul to prevent future losses of expected devastating Istanbul Earthquake is done	Public-provincial	BU, METU,YTU, ITU	http://www.koeri.boun.edu.tr/depremmuh/
1998-	2	2.3	IBB	Seismic Analysis (8 Earthquake Recording Station Network)	Earthquake Monitoring and Recording	8 Earthquake Monitoring and Recording Stations are established	Public-provincial	BU-KOERI, TUBITAK-MAM	www.ibb.gov.tr/deprem/calismalarimiz.htm
2003-	2	2.4	IBB	Seismic Analysis (6 Earthquake Recording Station Network)	Earthquake Monitoring and Recording	6 Earthquake Monitoring Stations are established	Public-provincial	JICA	The Same
1999-	2	2.5	IBB	Analyzing Soil Exploration Reports	Mitigation Geophysics	Soil exploration reports from district municipalities are being analyzed every year	Public-provincial	District Municipalities	The Same
34.04.2001 - 31.04.2003	2	2.6	IBB	Testing New Methods for the Prediction of Earthquakes in the Marmara Region	Earthquake Scenario and Plan	Researching anomalies in spring water and soil radon gas and compare the results with GPS studies and seismological data to determine the relations between such anomalies and seismic activity	Public-provincial	(TUBITAK-MAM), (ITU), (FJG), (MTA), (LDEO), (CNR), (IMG)	The Same
2001-	2	2.7	IBB	Soil Databank	Information Management	Borehole data about Istanbul Metropolitan area have been collecting and establishing a digital databank	Public-provincial	YTU	www.ibb.gov.tr/deprem/calismalarimiz.htm
2000-	2	2.8	IBB	GIS	Information Management	IBB has been completed 90% of a GIS database for metropolitan municipality services' areas including disaster management	Public-provincial	ITU,Bogazici University, District municipalities	The Same

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
2001-2003	6	6.1	ITU-CEDM	National Emergency Management, Education and Exercise Implementation Program	Education and Training	educational project to provide sustainability to the emergency management system of Turkey via the training	Public-Central	FEMA, Ministry of Interior of Turkey	http://www.aym.itu.edu.tr/
2001-2004	6	6.2	ITU-CEDM	A Cooperative Hazard Impact reduction Effort Via Education (ACHIEVE)	Education and Training	Educating and training responsible disaster managers	Public-Central	PMCMC, FEMA, GDDA	The Same
2001-2003	6	6.3	ITU-CEDM	Development of National Emergency Management Model	Earthquake Scenario and Plan	Conducted research to provide data to create an appropriate disaster management structure for Turkey	Public-Central	Ministry of Interior of Turkey	The Same
2001-2003	6	6.4	ITU-CEDM	The development of National Database using GIS & Remote Sensing Systems and the Standards for a Disaster Management System	Information Management	creating a nationwide GIS-based for disaster information management system	Public-Central	(SPC) of Ministry of Interior of Turkey	The Same
2001	6	6.5	ITU-CEDM	Red Cross Education Project	Education and Training	First Aid Training, Community Emergency Response Team Training, GIS education, Resistance Community Training	Public-Central	KIZILAY, FEMA	The Same
2001-2003	6	6.6	ITU-CEDM	The Restructuring of the Turkish Fire Brigades	Emergency Response	Conducted research to establish a proper structure to increase efficiency and coordination of fire services in Turkey	Public-Central	Ministry of Interior of Turkey, Turkish Firebrigade Assoc.	http://www.ins.itu.edu.tr/insaat/anabil/betonerm/ai14.htm
2003-2004	6	6.7	ITU-CEDM	Disaster Prevention Education Program	Education and Training	Education and training activities for disaster responsible public managers in Japan and In Turkey	Public-Central	JICA, Sumitomo Co.	http://www.aym.itu.edu.tr/
2002	6	6.8	ITU-CEDM	Protocol with AKUT&TRAC	Communication	Volunteer training program, developing communication infrastructure	Public-Central	AKUT, TRAC	The Same
2000-2004	3	3.1	ITU	Earthquake Prediction System Based on Observing the Stress of Rocks by the Method of ULF Electric Field Measurement	Earthquake Prediction	At the first stage 30 stations were established for monitoring. At the second stage the data from these stations will utilized for early warning purposes	Public-Central	SAU, IU, Sponsored by Siemens, Turk Pirelli, Unilever, Sika, Ericsson, YBT, Tuncmatit	http://www.deprem.cs.itu.edu.tr/
1993-2000	3	3.2	ITU	Earthquake Disaster Prevention Project	Earthquake Scenario and Plan	a project aiming to collect seismological data, estimate the damage, and give the results to the responsible disaster managers immediately	Public-Central	JICA, ERD	The Same
	3	3.3	ITU	Use of Space Technologies for Earthquake Hazard Assessment and Monitoring	Earthquake-loss Assessment	remote sensing, GPS , GIS are used to estimate future earthquake risk and damage assessment	Public-Central	ESA	http://www.ins.itu.edu.tr/jeodezi/jeodezi_e.htm
2001-2002	3	3.4	ITU	Determining Current Tectonic Features of Central part of NAF by GPS measurements	Mitigation Geodesy	16 GPS network are installed in the summer of 2001. The project aims to determine the parts of NAF between Ladik&Ilgaz by GPS	Public-Central	TUBITAK-MAM	http://www.deprem.cs.itu.edu.tr/

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
October 1999-October 2000	3	3.5	ITU	Investigation of the Connection between Fault Line system and Geothermal Water	Earthquake Prediction	the connection between geothermal water and fault line system was researched after the Marmara earthquake in order to predict next earthquakes	Public-Central	TUBITAK	http://www.geop.itu.edu.tr/projeler.html
May 2001-November 2002	3	3.6	ITU	Investigations on the fault line in the North shore of Marmara Sea by using Electric and Electromagnetic Methods	Mitigation Geophysics	researches was done in the fault line of north part of the Marmara sea	Public-Central	TUBITAK	http://www.deprem.cs.itu.edu.tr/
11.01.2002 – 12.31.2003	7	7.1	TUBITAK	Upper Mantle Wave Propagation in the Southern Anatolian Region	Earthquake Monitoring and Recording	22 Earthquake recording station is established	Public-Central	MIT	TUBITAK.gov.tr
02.01.2001 – 31.12.2004	7	7.2	TUBITAK	Dynamic Characteristic of West and Middle Part of North Anatolian Fault Line: Marmara Continues GPS Network (MAGNET)	Earthquake Monitoring and Recording	Establishing new stations to monitor changes/movements in the West and Central Anatolian fault line to determine earthquake risk	Public-Central	BU-KOERI, GCM, ITU	The Same
20.03.2000 – 31.08.2000	7	7.3	TUBITAK	Investigation of Seismic Ground Amplification In the Avcilar Region	Emergency Recovery	Seismologic researches are conducted after the Marmara Earthquake	Public-Central	Avcilar Municipality	The Same
18.07.2001 – 14.07.2004	7	7.4	TUBITAK	Seismological Network Calibration between Israel and Turkey	Information Management	This project aims to establish a database about micro-earthquake activities, seismo-tectonic data of East Mediterranean Sea	Public-Central	(GII)	The Same
20.06.2003 – 15.12.2003	7	7.5	TUBITAK	Spring Water And Soil Radon Gas Monitoring: A Search For Possible Precursors Of Earthquake Activity In The Marmara Region	Earthquake Prediction	researching the relationship between soil radon gas and spring water, and earthquake risk to predict future damaging earthquakes	Public-Central	IBB	The Same
01.07.2001 – 01.07.2002	5	5.1	TUBITAK-MAM	French-Turk SEISMARMARA Joint Project in the Marmara Sea. Seismologic Observation and Cinarcik-Pendik Seismic profile	Mitigation Geophysics	Seismologic research are conducted in the Marmara Sea	Public-Central	IU, ITU,KOU, MTA, SHOD, French Team	The Same, *Cumhuriyet* Science and Technical content analysis
16.04.2002 – 29.11.2002	5		TUBITAK-MAM	A Wide Angle Seismic Refraction/Reflection profile in the Province of Adapazari	Mitigation Geophysics	The data of seismic risk for Adapazari is collected	Public-Central	(TITech)	The Same
16.04.2002 – 13.12.2002	5	5.2	TUBITAK-MAM	Seismologic Data Quality and Continuity Studies	Information Management	Technical support for continuous data quality of earthquake recording stations is performed	Public-Central	IBB	The Same
30.10.2001 – 31.10.2002	5	5.3	TUBITAK-MAM	Tsunami Risk in the Marmara Sea	Tsunami Studies	The risk of tsunami in the Marmara Sea is researched	Public-Central	TUBITAK	The Same

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
01.03.2004 – 30.06.2004	5	5.4	TUBITAK-MAM	Establishing a Soil Radon Gas Measurement System in Elazig region in the East Anatolian Fault Line	Earthquake Monitoring and Recording	One soil radon gas observation station is established in the East Anatolian Fault Line	Public-Central	FU	The Same
01.06.2002 – 01.06.2004	5	5.5	TUBITAK-MAM	Investigation of Crustal Velocity Structure of Marmara Sea from the Analysis of Seismarmara 2001	Mitigation Geodesy	the project is aim to analyze the data collected from the first Seismologic research in the Marmara Sea and establish a knowledge base	Public-Central	IU, ITU,KOU, MTA, SHOD, French Team	The Same, *Cumhuriyet* Science and Technical content analysis
2003-	5	5.6	TUBITAK-MAM	Investigation of Crustal Deformation and Block Kinematics along the Eastern Sector of the NAF by GPS Measurements	Mitigation Geodesy	investigating crustal deformation and block kinematics by (GPS) measurements in and around the eastern sector of the (NAF) Zone	Public-Central	BU-KOERI, YTU, Turkey National Geodesy and Geophysics Association	http://www.koeri.boun.edu.tr/ /jeodezi/default.htm
25.03.2004 – 24.12.2004	5	5.7	TUBITAK-MAM	Studies of the Earthquake Prediction in the Marmara Region	Earthquake Prediction	supplementary researches to the project of Spring Water And Soil Radon Gas Monitoring: A Search For Possible Precursors Of Earthquake Activity In The Marmara Region	Public-Central	IBB	TUBITAK.gov.tr
02.01.2001 - 31.12.2004	5	5.8	TÜBİTAK-MAM	High Resolution Long term Earthquake Monitoring Project; Marmara Region Continuous Seismology Observation Network (MARSIS)	Earthquake Monitoring and Recording	Seismologic, geodetic and geologic studies are conducted to establish a database for determining future earthquake risk	Public-Central	Avcilar Municipality, IBB	The Same
25.11.2003 - 16.05.2005	5	5.9	TUBITAK-MAM	TUBITAK's GIS Studies for the Yalova Municipality within the Framework of MERP	Information Management	it aims to create a GIS database for Yalova city for land use management and disaster management purposes	Public-Central	Gumulcine Municipality-Greece, Yalova Municipality, EUF	The Same
15.07.2003 - 14.07.2005	5	5.10	TUBITAK-MAM	Monitoring Deformation Cycle of 1999 Izmit-Duzce Earthquakes	Earthquake Recovery	researches to determine the deformation after the Marmara earthquake	Public-Central	MIT,UNAVCO, EUREF	The Same
01.08.2003 - 31.05.2005	5	5.11	TUBITAK-MAM	Gebze-Kartal Seismic Zone: Earthquake Risk and Evaluation of Seismic Threat	Earthquake Monitoring and Recording	Seismological studies will be conducted	Public-Central	TUBITAK	The Same
1999-2001	35	35.1	GCM	Turkish National Fundamental GPS Network (TUTGA)	Earthquake Monitoring and Recording	16 stations are established throughout Turkey. The ultimate goal is to establish 50 stations.	Public-Central	TUBITAK-MAM, METU, UNAVCO, MIT, KTU, DU, SU, BKG,ITU	Onur Lenk
2002-	35	35.2	GCM	Turkish Sea Level Monitoring System	Earthquake Monitoring and Recording	to monitor the sea level and shoreline variations along our coasts and to test the existing geoids	Public-Central	TUBITAK-MAM, METU, YTU, Turkish National Geodesy and Geophysics Association	The Same
2000-	40	40.1	Kizilay	Disaster Coordination Center	Coordination	A disaster coordination center was established in Ankara to coordinate recovery and relief efforts by Kizilay after earthquakes	Nonprofit-National	UN	Dilek Kocak&Oktay Ergunay

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
2005-	41	41.1	Kizilay-AFOM	Alarm Satellite Systems	Erthquake Prediction	A satellite early warning system is planned to be established	Nonprofit-National	ERD, METU	www.kizilay.org.tr
2000-	41	41.2	Kizilay-AFOM	Logistic Management	Coordination	Coordination and management of outside assistances and inventories before and during earthquakes	Nonprofit-National	TUBITAK	www.kizilay.org.tr
2001-2004	41	41.3	Kizilay-AFOM	Risk Assessment Systems by GIS	Risk Assessment	Risk assessment models are created for every region of Turkey by using GIS	Nonprofit-National	Kizilay and UN sponsored	www.kizilay.org.tr
01.08.2003 - 01.12.2005	14	14.1	YTU	Micro-Deformations aspects of Local Region Between Gebze and Tuzla	Earthquake Recovery	researches to determine the deformation between Tuzla-Gebze, after the Marmara earthquake	Public-Central	TUBITAK-MAM, Darmstadt University of Technology-Institute of Physical Geodesy	ytu.edu.tr
2003-	14	14.2	YTU	Disaster Management Information System (AFAYBIS)	Information Management	For a chosen pilot area of (Istanbul), GIS database is aimed to be created for the purpose of disaster communicational and coordination	Public-Central	Prime Ministry Office, IPG	The Same
1992-1999	76	76.1	ESC	The Global Seismic Hazard Assessment Program	Damage Assessment	The first seismic hazard map is created for European-Mediterranean region	Nonprofit-International	BU-KOERI, NSSP,IS, IGTiblisi, EMGE, JIPE, IIEPTMG, GI, ING, IGZurich, IIEES, GFZ, IRM, IRRS	http://www.koeri.boun.edu.tr/depremmuh/
1992-2002	76	76.2	ESC	The ESC-SESAME project (European Seismological Commission -IUGS Program Project no. 382)	Damage Assessment	The first unified model for Probabilistic Seismic Hazard Assessment for European Mediterranean is created	Nonprofit-International	BU-KOERI, GFZ, ETHZ-Zurich, CSIC, NSSP,IS, IGTiblisi, EMGE, JIPE, IIEPTMG, GI, ING, IGZurich, IIEES, IRM, IRRS	http://www.koeri.boun.edu.tr/depremmuh/
2001	27	27.1	KOU	Seismic Microzonation of Izmit and its surroundings using by GIS	Risk Assessment	Seismic microzonation studies are conducted in the city of Izmit and her environment in order to examine the impact of Kocaeli earthquake and analysis for future risks	Public-Central	Penn Central, DPT, TUBITAK	http://www.kou.edu.tr/rektorluk/yayin/DPT.htm
Completed in 1999	51	51.1	Izmir Municipality	An Earthquake Damage Scenario and Earthquake Master Plan for the city of Izmir	Earthquake Scenario and Plan	created damage assessment scenarios and a master plan for the city of Izmir	Public-provincial	BU-KOERI, ITU	koeri.boun.edu.tr
1996-2000	52	52.1	Bursa Municipality	GIS	Information Management	A GIS disaster database has been established	Public-provincial	Zonguldak Karaelmas University	Ramazan Tuncer, Head of fire department
2003-	52	52.2	Bursa Municipality	Provinces Crisis Center Department Project	Coordination	this project aims to establish a fire department building inside the center of province crisis management to coordinate rescue efforts and various assistance during a disaster (a 911 prototype project)	Public-provincial	Bursa Province Government	Ramazan Tuncer

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
December 1999-2001	34	34.1	Duzce Municipality	DIMSIS-GIS. Development of Disaster-Management Spatial Information System	Information Management	creating a GIS database of for the disaster management purposes	Public-provincial	Kyoto University	http://www.duzce-bld.gov.tr/2.html
04.04.2001-13.06.2002	56	56.1	Bolu Government	Establishing Fundamental GIS Layers for City of Bolu	Information Management	Bolu Government and TUBITAK jointly created basic layers for establishing GIS database for Bolu	Public-provincial	TUBITAK-MAM	http://www.nemrut.MAM.gov.tr/
2001	56	56.2	Bolu Government	GIS urban knowledge base	Information Management	A GIS urban knowledge base has been establishing for the purposes of land use management and as well as disaster management	Public-provincial	Bolu Municipality, Abant Izzet Baysal University, Bolu Ticaret ve Sanayi Odasi, TUBITAK-MAM, DEU	Ismail Eroglu, Deputy Governer of Bolu
2001-2004	38	38.1	Sakarya Government	GIS urban knowledge base	Information Management	A GIS urban knowledge base has been established for the purposes of land use management and as well as disaster management	Public-provincial	DEU	www.sakarya.org.tr
2000-	8	8.1	IPG	GIS urban knowledge base	Information Management	A GIS database created for city of Istanbul for many purposes including disaster management	Public-provincial	Bogazici University, ITU, District Disaster Management Centers	www.istanbul.org.tr
2000-2003	8	8.2	IPG	Information Network Project	Coordination	A communication network is established among district crisis management centers and Istanbul Crisis Management center	Public-provincial	District Disaster Management centers	The Same
2003-	8	8.3	IPG	Disaster Station for each Neighborhood	Emergency Response	Disaster stations including some necessary equipments are aimed to establish in 32 district center for immediate need for rescue operations in future earthquakes	Public-provincial	District Disaster Management centers	The Same
2001-2004	20	20.1	PIU	Marmara Earthquake Rehabilitation Program	Emergency Recovery	reconstruction facilities, psycho-social rehabilitation activities and assisting municipalities for implementation of their disaster plans	Public-Central	Duzce, Yalova, Izmit, Sakarya, Bolu Municipality, (GPG), (ERR), .(ECC) supported by EU and GPG	The Same
2000-2003	20	20.2	PIU	Turkey Earthquake Rehabilitation and Reconstruction Assistant (TERRA) Project	Emergency Recovery	different rehabilitation and reconstruction efforts were undertaken	Public-Central	Financed by (EIB)	http://www.pub.gov.tr/projects.html
1998-2002	20	20.3	PIU	Turkey Earthquake and Flood Emergency Recovery (TEFER) Project	Emergency Recovery	recovering damage and developing hazard mitigation strategies	Public-Central	MPWS,HAD,DSI, DMI, EIE, MTA, Financed by WB	The Same
December 1999- May 2005	20	20.4	PIU	Marmara Earthquake Emergency Recovery (MEER) Project	Emergency Recovery	establishing EMAT, establishing TCIP, public awareness, coordination of emergency agency	Public-Central	GDDA, GDCD, MPWS, GDI, GDLRC, GDSL, Financed by WB	The Same
1998-2002	26	26.1	Turkish Treasury	Turkish Improvement of Natural Hazard Insurance and Disaster Funding Strategy (part of TEFER	Emergency Recovery	established a disaster insurance policy	Public-Central	WB, Cordiss Willis, CAR, BU-KOERI, ITU, METU, (LEL&OC-UK)	The Same

Project Date	N	K	Organization	Project Name	Type, T	Transaction	Source of Funding	Interactions	Data Sources
2000	19	19.1	GDCD	Professional Rescue Groups	Emergency Response	11 Professional rescue groups (120 individuals) are established	Public-Central	Adana, Afyon, Ankara, Bursa, Diyarbakir, Erzurum, Istanbul, Izmir, Sakarya, Samsun, Van (CMC)	Ahmet Bumin, Department Head, GDCD
2000-	137	137.1	GDLRC	Marmara Earthquake Recovery Land Identification System (MERLIS) –part of MEER-	Mitigation Geodesy	crating a land registry and cadastre information system which will be based for reconstruction for the earthquake region	Public-Central	YG, SG, KG, Financed by WB	http://www.tkgm.gov.tr/
March 2002-February 2004	12	12.1	GDDA	Seismic Microzonation for Municipalities (microzonation for Earthquake Risk Mitigation, MERM)	Risk Assessment	The application of microzonation maps for better land use management and administration	Public-Central	DRM, SDC, BU-KOERI, METU, GDDA, SAU, (ETHZ-IG), (EPFL-IS), (ETHZ-IGT), (SLF), (VT), (UP), Studer Engineering, Wharton School, KG, SG,	The Same
200-2003	9	9.1	ERD	Enhancement of the National Strong Motion and Establishing Seismic Arrays in Turkey	Earthquake Monitoring and Recording	20 modern acceleration recording instruments around two arrays (*e.g.* Yalova-Bursa and Aydin-Denizli) are positioned	Public-Central	METU, ITU, UNR, TUBITAK, USGS, supported by NATO,	http://angora.deprem.gov.tr/projeen.htm
2002-2003	9	9.2	ERD	Establishment of Local Strong Motion Seismic Array-K.Maras-Antakya Strong Motion Network	Earthquake Monitoring and Recording	18 modern acceleration recording instruments around the arrays (*e.g.* Antakya-Maras) are positioned	Public-Central	METU, ITU, UNR, TUBITAK, USGS	The Same
2000-	33	33.1	TRAC	Wireless Communication Network	Communication	TRAC opened a permanent station in provinces crisis management center	Nonprofit National	SG, BG, KG,IPG	Aziz Sasa, President of TRAC
2000	33	33.2	TRAC	Agreement for Emergency Communication	Communication	TRAC and interacted organizations agreed on logistic, technical, information sharing and increasing human resources in order to supply better communication for disaster purposes	Nonprofit National	IFRC, Kizilay, PMCMC, GDCD	Aziz Sasa, President of TRAC

APPENDIX J

TWO POPULATION PROPORTIONS TEST RESULTS

Communication
Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of communication for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of communication for the Duzce is more than for the Marmara)

Significance level = 0.05

Sample	X	N	Sample p
1	34	274	0.124088
2	63	1112	0.056655

Difference = p (1) - p (2)
Estimate for difference: 0.0674329
95% lower bound for difference: 0.0327448
Test for difference = 0 (vs > 0): Z = 3.92 P-Value = 0.000

Coordination of response
Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of coordination of response for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of coordination of response for the Duzce is more than for the Marmara)

Significance level = 0.05

Sample	X	N	Sample p
1	15	274	0.054745
2	39	1112	0.035072

Difference = p (1) - p (2)
Estimate for difference: 0.0196726

95% lower bound for difference: -0.00468531
Test for difference = 0 (vs > 0): Z = 1.51 P-Value = 0.066

Critical assessment of disaster management performance
Test and CI for Two Proportions

$H_0 : p1 = p2$ (percentage of critical assessment of disaster management performance for the Marmara and Duzce is equal)
$H_a : p_1 > p_2$ (percentage of critical assessment of disaster management performance for the Duzce is less than for the Marmara)

Significance level = 0.05

Sample	X	N	Sample p
1	9	274	0.032847
2	67	1112	0.060252

Difference = p (1) - p (2)
Estimate for difference: -0.0274051
95% upper bound for difference: -0.00615783
Test for difference = 0 (vs < 0): Z = -1.78 P-Value = 0.037

Damage Assessment
Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of damage assessment for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of damage assessment for the Marmara and Duzce is not equal)

Significance level = 0.05

Sample	X	N	Sample p
1	13	274	0.047445
2	52	1112	0.046763

Difference = p (1) - p (2)
Estimate for difference: 0.000682666
95% CI for difference: (-0.0273817, 0.0287470)
Test for difference = 0 (vs not = 0): Z = 0.05 P-Value = 0.962

Disaster relief/human services
Test and CI for Two Proportions

$H0 : p1 = p2$ (percentage of disaster relief/human services for the Marmara and Duzce is equal)
$H_a : p_1 > p_2$ (percentage of disaster relief/human services for the Duzce is less than for the Marmara)

Significance level = 0.05

Sample	X	N	Sample p
1	64	274	0.233577
2	361	1112	0.324640

Difference = p (1) - p (2)
Estimate for difference: -0.0910636
95% upper bound for difference: -0.0430937
Test for difference = 0 (vs < 0): Z = -2.93 P-Value = 0.002

Health and Medical care
Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of health and medical care for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of health and medical care for the Marmara and Duzce is not equal)

Significance level = 0.05

Sample	X	N	Sample p
1	26	274	0.094891
2	93	1112	0.083633

Difference = p (1) - p (2)
Estimate for difference: 0.0112574
95% CI for difference: (-0.0270684, 0.0495833)
Test for difference = 0 (vs not = 0): Z = 0.60 P-Value = 0.551

Legal issues/legal enforcement
Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of legal issues/legal enforcement for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of legal issues/legal enforcement for the Duzce is more than for the Marmara)

Significance level = 0.05

Sample	X	N	Sample p
1	6	274	0.021898
2	58	1112	0.052158

Difference = p (1) - p (2)
Estimate for difference: -0.0302605
95% upper bound for difference: -0.0120458
Test for difference = 0 (vs < 0): Z = -2.14 P-Value = 0.016

Post-disaster research
Test and CI for Two Proportions

Sample	X	N	Sample p
1	7	274	0.025547
2	28	1112	0.025180

$H_0 : p_1 = p_2$ (percentage of post-disaster research for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of post-disaster research for the Marmara and Duzce is not equal)

Significance level = 0.05

Difference = p (1) - p (2)
Estimate for difference: 0.000367589
95% CI for difference: (-0.0204607, 0.0211959)
Test for difference = 0 (vs not = 0): Z = 0.03 P-Value = 0.972

Public information
Test and CI for Two Proportions

Sample	X	N	Sample p
1	13	274	0.047445
2	85	1112	0.076439

$H_0 : p_1 = p_2$ (percentage of public information for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of public information for the Duzce is less than for the Marmara)

Significance level = 0.05

Difference = p (1) - p (2)
Estimate for difference: -0.0289936
95% upper bound for difference: -0.00413355
Test for difference = 0 (vs < 0): Z = -1.68 P-Value = 0.047

Resource support
Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of resource support for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of resource support for the Duzce is less than for the Marmara)

Significance level = 0.05

Sample	X	N	Sample p
1	5	274	0.018248
2	27	1112	0.024281

Difference = p (1) - p (2)

Estimate for difference: -0.00603240
95% upper bound for difference: 0.00928230
Test for difference = 0 (vs < 0): Z = -0.60 P-Value = 0.276

Search and rescue
Test and CI for Two Proportions

$H_0 : p_1 = p_2$ (percentage of search and rescue for the Marmara and Duzce is equal)
$H_a : p_1 < p_2$ (percentage of search and rescue for the Duzce is more than for the Marmara)

Significance level = 0.05

Sample	X	N	Sample p
1	70	274	0.255474
2	89	1112	0.080036

Difference = p (1) - p (2)
Estimate for difference: 0.175438
95% lower bound for difference: 0.130081
Test for difference = 0 (vs > 0): Z = 8.16 P-Value = 0.000

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